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(Formerly Railway Signaling & Communications)

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RSC News

Chessie opens new Data Center

What used to be a Yard Office for the Chessie System in Cumberland, Md. is now a Data Center.

Yard and agency personnel have joined forces and, with the aid of new equipment, are performing a sophisticated operation. It involves the movement of trains and cars in and through the terminal and the gathering and reporting of accurate billing information on merchandise traffic and coal shipments being classified, originated or terminated in Cumberland.

The Data Center, in operation since May 1, is the first installation of its kind on Chessie System. It consolidates all yard and agency procedures—"getting it all together" under one roof, explained Richard G. Rayburn, assistant vice-president of transportation, Chessie.

Rayburn went on to say that it has long been evident that a better organization and more efficient operation were needed in Chessie's yard and agency offices. Rayburn has been working toward the implementation of the Data Center concept with William L. Sheridan, manager of planning in Baltimore, and his staff.

"These older offices today are in many cases unsuitable for modern data processing equipment," said Mr. Sheridan. "The environment in which the clerks must work is not conducive to efficiency. There are redundant clerical operations performed countless times. Some office methods have not advanced with our new technology," he said.

"The Transportation Department—in this case, the Maryland Division and our headquarters offices-has developed a concept which takes all these problems into consideration," Mr. Sheridan added.

"Clerical functions of the Cumberland terminal have been brought together into one office, leaving only those functions in the outlying yards which must remain, due to their nature. At Cumberland, there are now only two clerks on each shift actually out in the yard—one in the westbound yard and one in the eastbound."

"Cumberland is the model for similar setups in other large terminals," Mr. Sheridan said. Other terminals with similar big classification yards and scattered yard office facilities include Willard, Cincinnati, Toledo and Chicago.

In the Cumberland yard complex, there are 208 tracks—64 of which are used for classification. About 2,500 cars a day come into the terminal—about 1,200 each for classification eastbound and westbound. The balance originates or terminates in Cumberland.

These cars are brought in by an average of 32 trains daily—five of which are run-throughs.

WABCO orders Sperry Univac 90/70 system

The Westinghouse Air Brake Co. (WABCO) has ordered a Sperry Univac 90/70 computer system, valued at $1,147,625, for manufacturing, inventory control, and many other applications at its Data Center located in Monroeville, Pa.

The new system will extend and improve the Transportation Group's online application capabilities in applied research, design and manufacturing engineering, distribution center management, and general customer service.

Applications include data base retrieval and updating, maintaining general manufacturing bills of material, product design, simulations, inventory control, general accounting, payroll, order entry, and cost control.

The computer system includes 524,000 bytes of main memory, eight UNISERVO 16 magnetic tape subsystems, six 8424 disc subsystems with 348-million bytes of mass storage, an 0770 printer, and an 0716 reader.

Burroughs supplies computer for Alaska Railroad

The Alaska Railroad, the northernmost railway system in the U.S., has awarded Burroughs Corp. a contract valued at nearly $800,000, for a B 2700 medium-scale computer system. The new system, scheduled for installation at Anchorage in August of this year will include Burroughs remote inquiry terminals at Anchorage and Fairbanks, Alaska.

The Burroughs system will be used by the Railroad's Operations Division to process financial and personnel data, and to handle inventory, supply and logistical operations, including freight car accounting.

WABCO to supply equipment for L & N

Union Switch & Signal Division of WABCO has received an order from the Louisville & Nashville for the design and manufacture of an automatic freight car classification system for a 49 track yard to be installed at Strawberry Yard, Louisville, Ky.

Included in the equipment to be furnished are electro-pneumatic car retarders and switch machines, automatic routing and retarder speed control, 2 control and monitoring panels, and dual digital computers to be linked to dual management information computers provided by the L & N.

The WABCO system will use power controlled skate retarders to anchor the first cars into the classification tracks and thus provide, when released, noiseless operation when trains are being removed from these tracks.

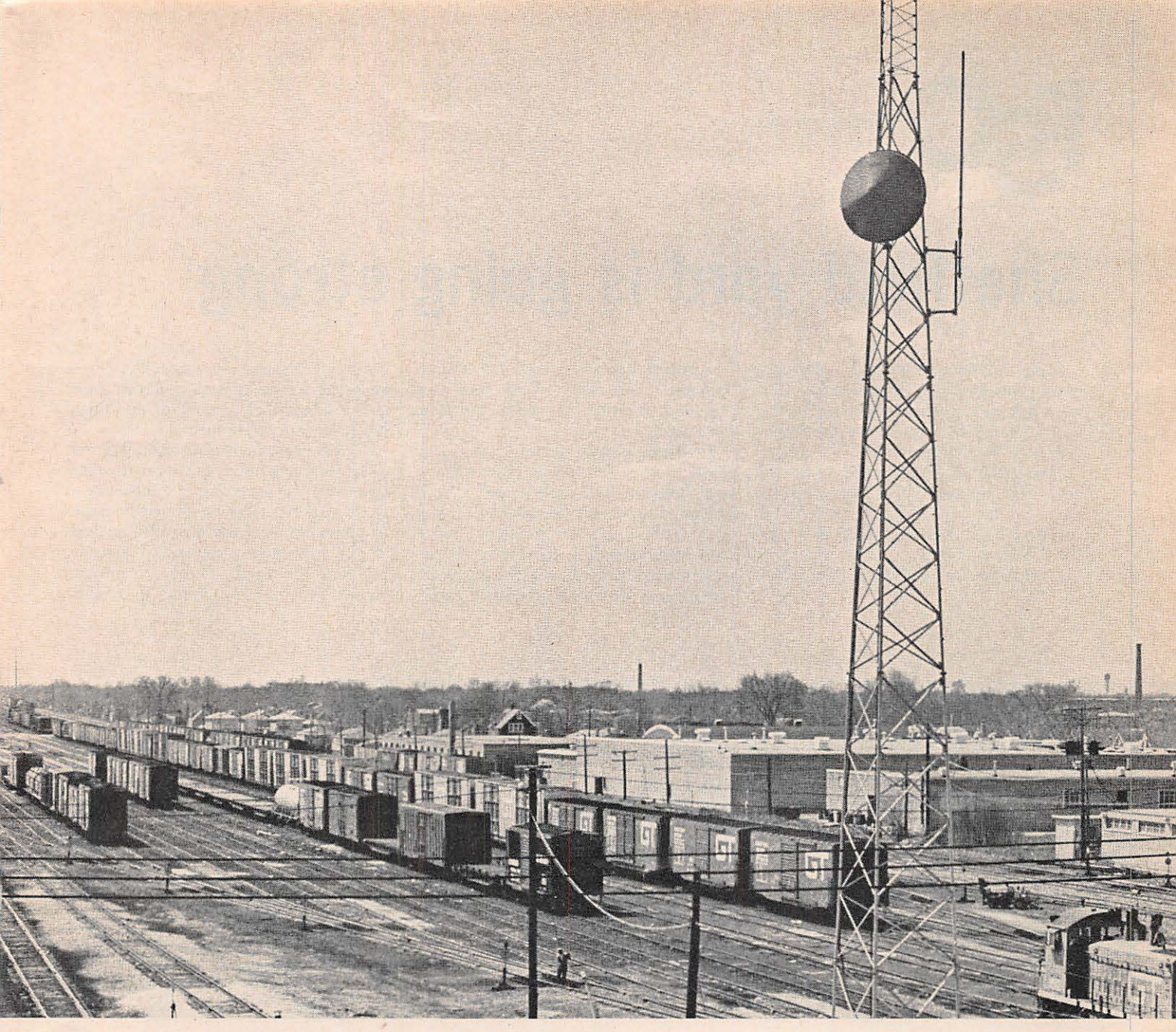
Also to be provided is a system that provides cab signals and automatic speed regulation for humping locomotives controlled by radio from the yardmasters control console.

GRS to provide signal equipment for CTA

A major contract for expediting the installation of modern cab signaling on three remaining Chicago Transit Authority rapid transit routes was awarded on June 28, by the Chicago Transit Board. The contract, which represents the last project in a major program to provide the entire rapid transit system with safe and reliable signaling equipment, was awarded to the General Railway Signal Co. on a low bid of $12,109,448.

Under terms of the contract, the installation of the wayside equipment for cab signaling on three remaining rapid transit routes—Ravenswood, Evanston-Wilmette and Skokie Swift. In accordance with the bid advertising by the CTA, installation of the wayside equipment must be completed within 18 months for the three routes. "For the Ravenswood route, this will mean that this important work must be completed a full year sooner than originally planned," said Milton Pikarsky, CTA Chairman. On May 16, the CTA Board advertised for bids for the last big signaling project after having obtained special permission to advance the timetable for the work from the Urban Mass Transportation Administration of the U.S. DOT and the Illinois Department of Transportation.

The signaling work is being done under the CTA's $140-million modernization program for which the federal government is providing two-thirds of the cost and the state government one-third.



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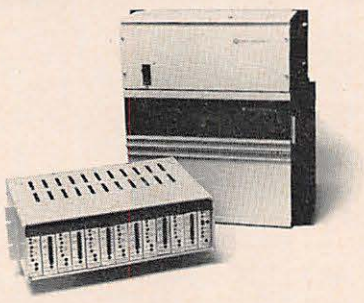

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Sheffield yard is going strong

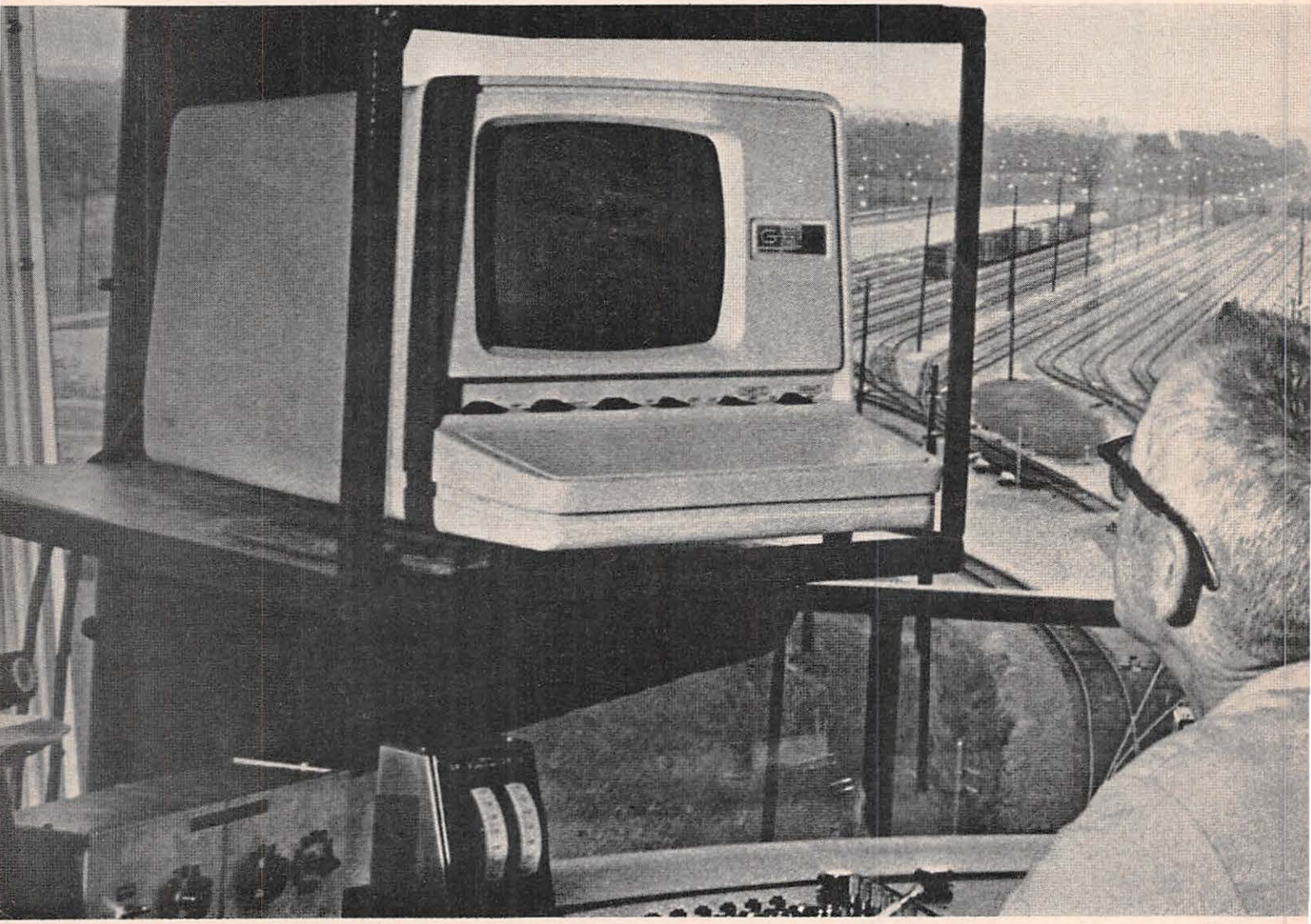
Since Southern Railway's minicomputer-controlled yard at Sheffield, Ala., went into service during May of '73, the road's management has been keeping a close eye on its operation.

Has Sheffield yard lived up to Southern's expectations? What prime factors have led to the yard's success? What benefits have become evident since RSC first reported a story covering Sheffield's control system in September of '73?

A recent interview with L.S. Crane, Southern's Executive Vice President, provided answers to these questions and more.

Southern began planning the yard about three years ago and arrived at a cost figure of $15 million and a completion date set for the middle of May '73. Southern hit the predicted target date and, according to Crane, the expenses remained well enough below the cost estimate to install additional equipment not planned for originally. These included an additional pullback track and a substantial amount of additional fire protection equipment.

As for performance, Crane observed, "The yard has lived up to our expectations and has exceeded our forecasts of its capabilities. During the early stages of planning we made a careful analysis of the advantages we would gain by building the yard. These advantages, among others, were found to include



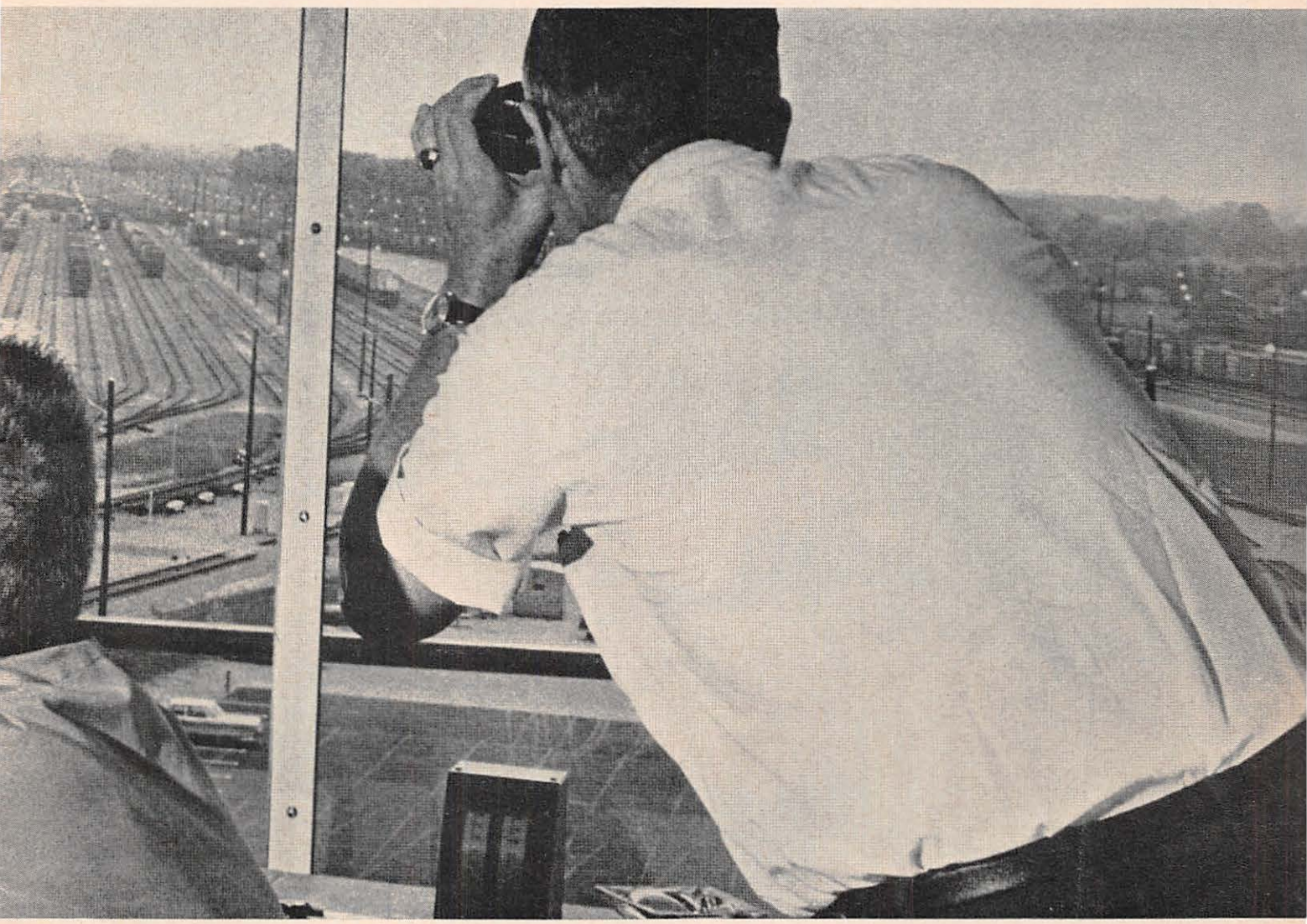
Hump conductor in Southern's Sheffield yard uses closed circuit television, a communications console and a CRT to

RAILWAY SYSTEM CONTROLS

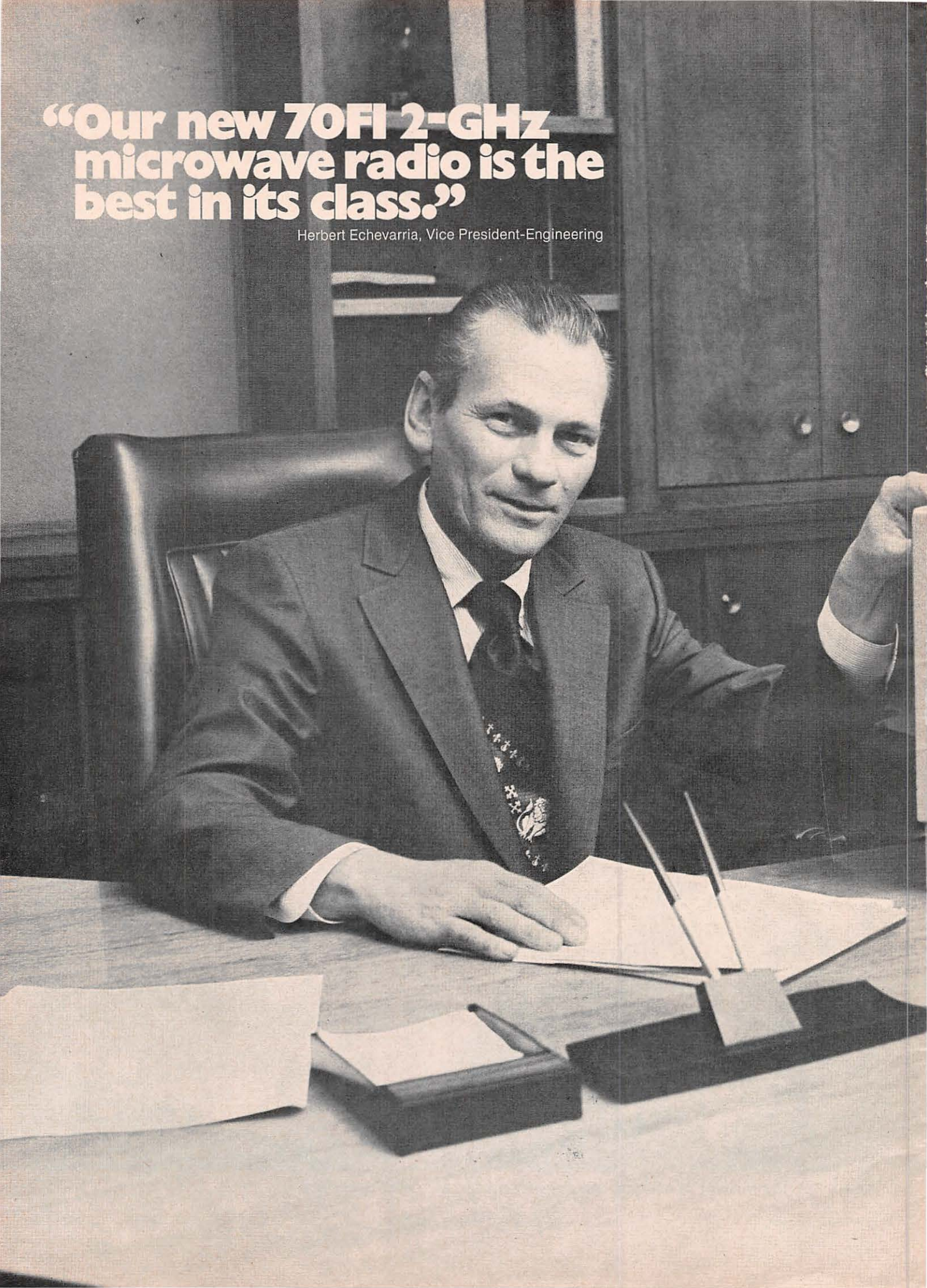
reduction of congestion at the yards in Chattanooga, Birmingham and Memphis. Of course, we did incur additional expenses such as crew cost, tax expense, mechanical expenses because of a new 'spot-repair' track, and expansion of C&S forces for maintenance of this sophisticated facility. Offsetting these expenses were savings in the improvement in car hire at Birmingham and Chattanooga because of improvement of handling cars at Sheffield. Savings also resulted from reduction of switching costs at Memphis since classification moves which we had performed at Memphis were transferred to Sheffield. Overall we gained additional revenue because of our increased capacity."

What outstanding factors have led to the yard's success? Crane says, "In planning Sheffield, we undertook a very intensive computer simulation to identify the improvements in train service which would result when the yard was built. The simulation also told us where and how much reduction of load would be felt." Crane went on to say that the careful planning, along with the computer simulation, was a major factor in the yard's success. He commented, "I personally feel that this is the best and most intensively pre-planned yard that has ever been built on Southern Railway."

Another feature contributing to the



maintain continuous monitoring of all hump operations for the 32-track classification yard.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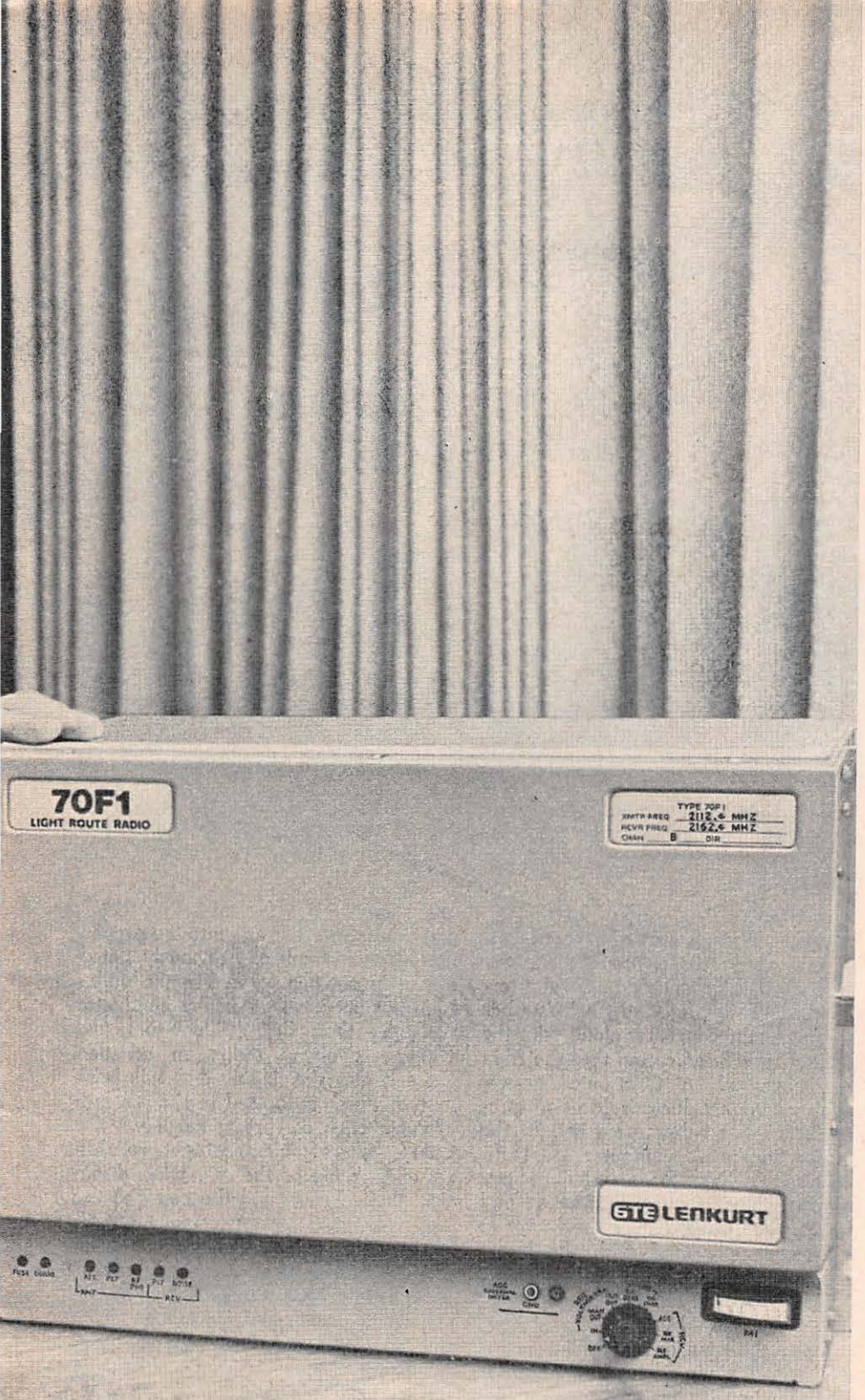
Herbert Echevarria, Vice President-Engineering



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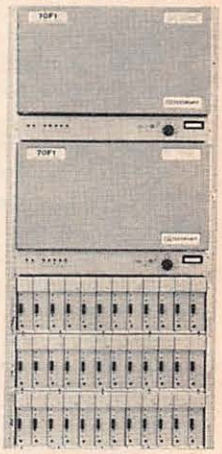

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yard's operating success is the automatic perpetual inventory tying in with Southern's Management Information System. Using the sophisticated communications system, advance consist information is sent to the main computer in Atlanta which stores information including the origin and destination of every car going through Sheffield with the exception of those that originate in the yard. Atlanta's computer prepares the switch list and sends it to Sheffield's process control computer which not only stores the information but also produces a hard copy of the switch list.

In order to transmit information and data not only to and from Sheffield but also within the yard itself, communications are vital to Sheffield's successful operation.

The communication system employed by Southern utilizes closed circuit television, microwave relays, two-way radio, talkback speakers, party line intercoms and a variety of other advanced electronics equipment which significantly increases both efficiency and accuracy of freight handling by the railroad.

The prime communication system contractor, Motorola Inc., along with the prime control system contractor, General Railway Signal Co., worked together to provide an efficient and reliable system. The resulting 32-track classification yard can be expanded to 40 tracks. Expansion is not foreseen in the immediate future. The present capacity of the yard is about 1,800 cars daily. Since the yard has opened, traffic has only rarely approached its peak; when needed, the yard can be expanded to handle about 2,400 cars in any 24-hour period.

Motorola's program for Southern covers consoles to consolidate all of the CCTV, microwave, radio paging and talkback. Motorola also supplied basic test equipment for a maintenance shop within Sheffield yard for keeping all of the communications systems on the air.

Over the hump

Yard operation begins when Southern's MIS computer in Atlanta transmits an "advance consist" through a data link to one of the five Nova 1200 minicomputers at Sheffield. This enables the yard personnel to know what the composition should be for any given train.

Armed with the information of the consist, a yard clerk views each train as it is brought into the receiving yard, using Motorola closed circuit television to visually inspect each arriving car and check it off against the consist. If the clerk is busy as the train comes into the yard, a videotape recording is made to play back later.

G. W. Johnson, a train clerk at Sheffield yard checks off the numbers on arriving freight cars from the video recorders as they appear on the closed circuit television monitor, recording the numbers on a tape recorder for future transcription.

After a train is yarded into the receiving yard, it is brought to the "hump." Using a cathode ray tube terminal, the receiving yard track number is input to the computer along with the instruction HP indicating that the train is to humped. A Centronics printer at the yard conductor's location provides him with a hump cut list. At the hump, Southern's computer automatically selects the proper and optimized humping speed for the locomotive and the cars are pushed over the hump at this optimized speed with the hump engine in automatic.

Closed circuit televison again comes into use as the hump engine begins bringing the train or individual cuts of cars to the hump for classification. As the train approaches the hump, automatic speed control takes over. A pin pull retarder is controlled by the hump-conductor, insuring the proper slack for pulling pins and uncoupling cars. Because of the hump conductor's location on the sixth floor of the Sheffield yard office, this operation cannot physically be seen, and closed circuit television monitors allow visual inspection throughout the procedure. Also, a CRT display allows him to see where cars are going. The hump conductor maintains control over all switches and retarders on the hump when in manual and oversees the automatic operation.

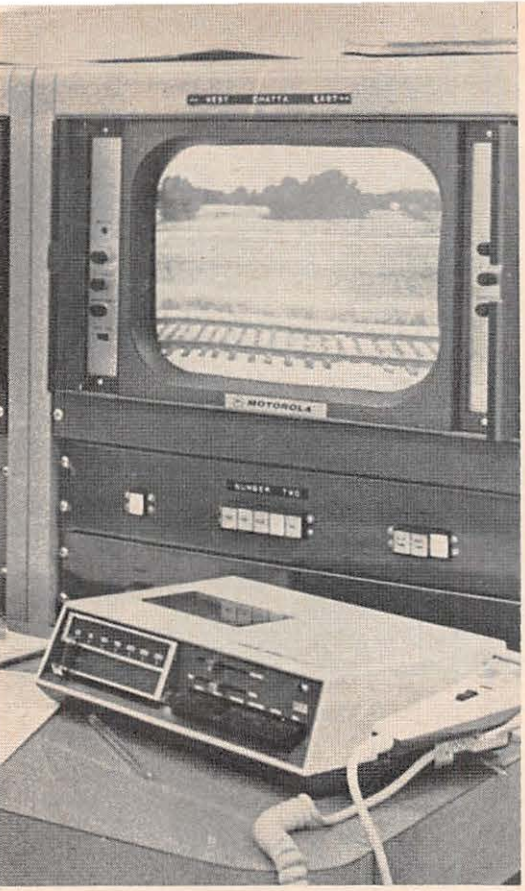
Once the car is cut, it rolls through the master retarder and into the proper-classification track as previously determined by the computer. The pin puller is in contact with the hump conductor through the CCTV monitor and through two-way radio. In addition there is also the paging and talk back system which is located in the pin pull area. As each car progresses down the hump, factors such as weight, rollability and profile of the car, wind direction and velocity, and the distance the car must travel before coupling are all dealt with by a computer to insure the coupling speed does not exceed 4 mph.

As cuts of cars are pulled from the classification yard and pushed back into the forwarding yard to make up outbound trains, they are monitored on the pullout CCTV console.

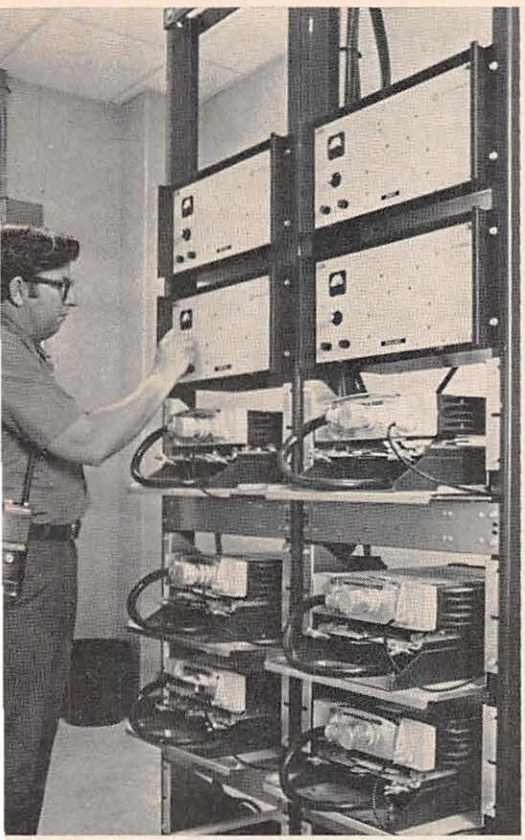
The closed circuit television cameras maintain a video recording of the trains passing in front of their line of vision, allowing Southern's yard personnel to go back and recheck car numbers without difficulty on the CCTV monitors. All transmission of CCTV images back to the yard tower are accomplished by Motorola MR-1200 microwave system which operates at 12 gigahertz.

Console system

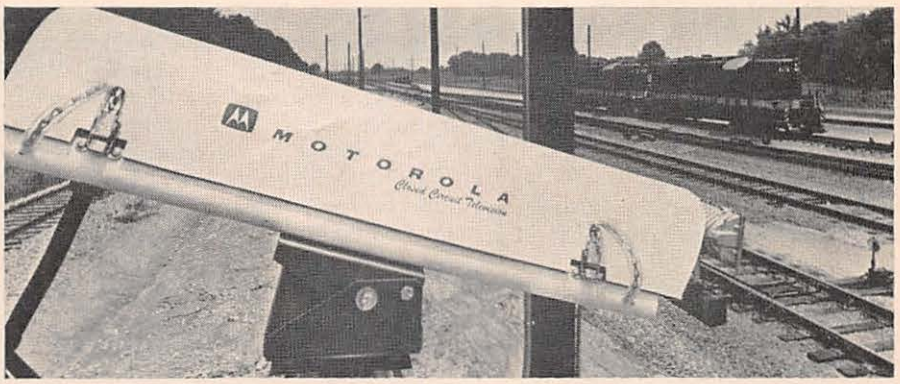
The console system is composed of a main console and approximately 10 smaller consoles located at strategic lo-



An employee at Sheffield yard studies the Motorola closed circuit television monitors from a vantage point in the Southern offices. The monitors enable the company to firmly establish both incoming and outgoing traffic and detect omissions and oversights in time to correct them without delays.



Paul LeDoux, communications and signal supervisor for Southern, inspects the closed circuit television microwave receivers in the road's yard.



A closed circuit television camera monitors the pullout section of the yard. Use of the CCTV system has enabled yard personnel to control the total yard operation from points far removed from the pullout location.

cations throughout the yard. The main console, located in the yardmaster's office, is capable of contacting any of about 25 "talkback" stations throughout the facility.

Southern's yardmaster in the Sheffield facility is positioned on the seventh floor of the yard office, from which he controls the total operation of the yard. A CRT monitor allows him to direct both incoming and outgoing train operations. Also the yardmaster controls the work order display for the pullout operation.

The work order display is backed up by voice communication, allowing the yardmaster to contact the pullout end of the yard in the event of a failure in the work order display panel. The radio system allows the yardmaster to communicate to all carmen at any location in the yard, enabling him to be in touch with yard personnel as they bleed and inspect the trains. This virtually gives each man his own talkback speakers which he carries with him.

The communication network at Sheffield—and the computer systems at Sheffield and Atlanta, Ga.—make up only part of Southern's massive program to install and overhaul yards and terminals in a way that is producing major improvement in the service delivered to the Southeast.

People

DENVER & RIO GRANDE WESTERN.—**R. L. Pernicka** appointed communications engineer, Denver.

ERIE LACKAWANNA.—**P. G. Bates** appointed division director data control, Marion Division, Marion, Ohio.

ILLINOIS CENTRAL GULF.—**Paul F. Deady** named vice president-communications and computer services. He was formerly director of financial systems, Eastern Air Lines.

NORFOLK & WESTERN.—**M. W. McMahon, Jr.,** regional engineer signals and communications, St. Louis, transferred to the A&P regions, Roanoke, succeeding **J. V. Henretta,** retired. **C. J. Talley** succeeds Mr. McMahon. **J. A. Sattler,** assistant regional engineer signals and communications, Lake Region, Cleveland, promoted to regional engineer there, succeeding **W. W. Bell,** retired. **A. Gear, Jr.,** assistant engineer, A&P Regions, Roanoke, succeeds Mr. Sattler. **W. E. White,** inspector, A&P regions, Roanoke, succeeds Mr. Gear.

W. R. Palmer appointed assistant engineer, signals and communications, Roanoke. **J. E. Hartfield** named manager signals-system, Roanoke. **R. I. Price, Jr.** appointed circuit engineer, Roanoke, succeeding **E. N. Frantz,** retired.

PENN CENTRAL.—**V. J. Cassella** appointed assistant manager-communications facilities.

Other recent appointments: Field engineers-communications and signals —**F. M. McNamar,** Chicago; **D. M. Geist,** Pittsburgh; **J. L. Lane,** New Haven; **R. E. Rohrbacher,** Philadelphia; **E. W. Simpson,** Detroit.

Engineers-C&S: **L. M. Haines,** Pittsburgh; **E. T. Eveland,** Detroit; **R. W. Mathews,** New Haven; **E. E. Harris, Jr.,** Chicago; **D. G. Shields,** Indianapolis; **J. E. Hartfield,** Philadelphia.

Assistant field engineers-C&S: **M. J. Rose,** Pittsburgh; **E. J. Gouin,** New Haven; **R. F. Jones,** Indianapolis.

General inspectors-C&S: **J. A. Crawford,** Detroit; **R. H. Koch,** Chicago.

Staff engineers-C&S: **S. M. George,** Detroit; **W. F. Pegelow,** Chicago.

ROCK ISLAND.—**Kenneth F. Galitz,** electronics engineer, named superintendent communications. **Walter B. Johnson,** signal engineer, named superintendent signals. **Donald L. Johnson,** assistant signal engineer, promoted to signal engineer. **G. W. Lash** promoted to assistant to general superintendent communications and signals, with responsibility for the administration of the department.

TORONTO, HAMILTON & BUFFALO.—**Stan Gieunuez,** signal project supervisor, **Canadian Pacific,** Toronto, Ont., appointed supervisor of communications & signals, TH&B, Hamilton, Ont. **R. Donaven,** general signal foreman, retired April 30, after 34 years of service.

SUPPLIERS

Robert H. Glines, sales engineer, **General Railway Signal Co.,** Chicago, has been appointed manager of industrial sales, Rochester, N.Y.

Richard Mather, formerly with **Harmon Electronics,** has been appointed vice president engineering sales, Railroad Products Division, **National Electric Control Co.**

Herman C. Haas has been elected a corporate vice president and director of marketing, **AMP Incorporated,** Harrisburg, Pa. Mr. Haas, who was vice president, Telecom Division, succeeds **W. C. Lange** as senior marketing officer. Mr. Lange retired July 1, after 23 years with AMP, but will continue in a consulting and advisory capacity.

Brand-Rex Co., a part of Akzona Inc., has completed the acquisition of **Teltronics, Inc.,** Lakeland, Fla.-based manufacturer of electronic telecommunications equipment. Teletronics will be operated as a division of Brand-Rex and no management changes are planned.

Claude N. Romans has been appointed to the position of chief engineer, PCM and Data Development, for **GTE Lenkurt Incorporated.** Romans replaces **William G. Chaney** who has been promoted to chief engineer of GTE's Albuquerque, N.M. manufacturing facility. In his new capacity, Romans will direct the engineering efforts of the company in the areas of pulse code modulation (PCM) carrier systems and data transmission systems.

John Larson, Parsons Company, St. Paul, Minnesota, will represent **National Electric Control Company,** Railroad Products Division, in the Midwest-Twin City area.

Which

Only

Progress in electronic hot box detector systems

The "Decision-Maker" Universal Alarm System brings the state-of-the-art in hot box detection to a new high level. And that's just what you'd expect from the No. 1 company in the field—Servo, the industry's pioneer designer and leading producer.

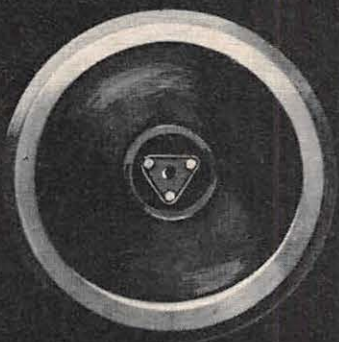
Since 1957, more than 1,800 SERVOSAFE Hot Box Detective Systems have been put into service world-wide, and have compiled an unequaled record of safety improvement, more efficient preventive maintenance procedures and cost reduction.

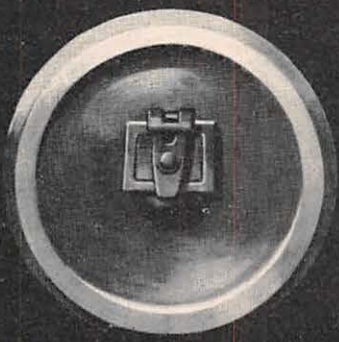
Hot box detectors available from Servo offer the widest flexibility in choice of system configuration, features and functional options. With our broad range of products and world-traveling network of field engineers, we can readily "customize" the design, manufacture, installation and operation of a SERVOSAFE System to best meet the particular requirements of your railroad.

You are invited to contact us for complete descriptive literature, or to arrange a field engineering site survey and application review—without obligation, of course.

Circle 6 on Reader Service Card.

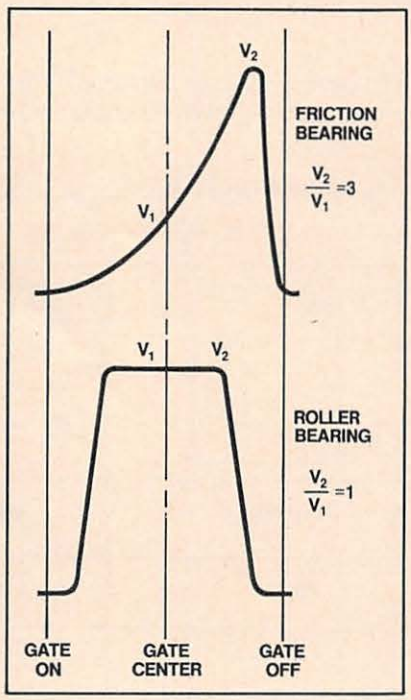
bearing has the hot box? the "Decision-Maker" knows!





Servo's new Universal Alarm System with automatic bearing identification*

The heart of our new Universal Alarm System is a unique bearing identification circuit known as "SWAT"—Split Waveform Analysis Technique. Because of their different heat transfer characteristics, roller and friction bearings produce different heat radiation "signatures" during the detector scan period. The SWAT circuit splits the gate scan period and compares V_1 with V_2. Typically, friction bearings produce a V_2/V_1 ratio of approximately 3, and roller bearings produce a ratio of approximately 1. The ratio sensed by the system is utilized to identify the type of bearing being scanned.



The "Decision-Maker" Universal Alarm is much more than the latest development in SERVOSAFE® Hot Box Detective™ Systems. It's a whole new concept designed to solve one of the toughest problems in hot box detection: **the difference in heat level characteristics between roller bearings and friction bearings**. The fact that normally-operating roller bearings run hotter than friction bearings has always presented a serious dilemma to railroad engineers. If you employ a low level alarm setting for early detection of overheated friction bearings, you run into the problem of too many false alarms on roller bearings. A higher setting to be consistent with roller bearings is not recommended as it can result in overheated friction bearings that pass by undetected.

Now, you don't have to make that difficult decision. Our new "Decision-Maker" Universal Alarm System will make it for you. It provides individually adjustable differential and absolute alarm levels for each type of bearing. It automatically distinguishes between roller and friction bearings, applies the proper alarm level, and actually makes the decision as to whether or not a hot box condition exists.

The Universal Alarm is available on new installations or as retrofit equipment for all existing models of SERVOSAFE Hot Box Detective Systems. If you'd like to put an end to the roller bearing vs. friction bearing problem, let us put the "Decision-Maker" to work on your railroad. Write or phone today for complete information.

*PATENT PENDING

See us at the Atlanta AAR Show Sept. 16-20 · Booths 9-10-11

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(Figures below are total given under specific categories in Business Analysis of Circulation NO. 18 SRDS, Jan. '74. edition).

CIRCULATION COMPARISON	Railway Age	Railway System Controls	MR	PR
CIRCULATION – Signaling & Communications Dept.	(237)	(1,874)	1,248	708
	2,111			
CIRCULATION – General Executives	(5,847)	(427)	6,464	1,858
	6,274			
TOTAL EFFECTIVE CIRCULATION	8,385		7,712	2,566
ADVERTISING COST PER 12 x SCHEDULE	$12,900*		$12,840	$5,700
COST PER THOUSAND PER PAGE	$128		$138	$181

THE RAILWAY AGE GROUP
350 Broadway
New York, N.Y. 10013
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INDUSTRIAL MARKETING RATE –
*Two 12x contracts get 24 time rate

Note: In combining RAILWAY AGE and RAILWAY SYSTEM CONTROLS there is a factor of duplication. Where duplication exists, in top supervisor areas, your advertising receives double readership through two ads.

Reliability engineering: Impact on transportation control systems

By H. C. SCHWARTZ
Manager Reliability Engineering
General Railway Signal Co.

At GRS, Reliability and Maintainability are recognized as essential techniques in the successful design of today's sophisticated transportation controls. To this end, GRS engineers combine many years of proven product performance with modern reliability techniques to produce a program that has demonstrated excellence in design while assuring reliable performance throughout a product's lifetime.

Planning

Reliability and maintainability begin during the initial planning stage when a request for proposal is received. The request is reviewed to determine objectives and feasibility of requirements, to identify possible technical problems and the need for design tradeoff studies, and to establish corrective action control methods.

Critical to a successful Reliability-Maintainability Program is its planning —determining guidelines to establish criteria for monitoring progress and evaluating ultimate satisfaction of constraints, objectives, schedules, and data requirements for an individual product.

Herbert C. Schwartz is Manager of Reliability Engineering for General Railway Signal Company and is responsible for all Reliability & Maintainability activities on Train and Rapid Transit Systems. He is the author of "Product Test & Evaluation" a John Wiley & Sons publication, and has delivered numerous papers on Reliability & Quality Assurance. He was a Charter Member of the Merrimac Massachusetts Chapter of ASQC and was instrumental in establishing the Boston Reliability Section of IEEE. Prior to joining GRS, Mr. Schwartz was Divisional Senior Staff Engineer, AVCO Systems. Mr. Schwartz is a registered professional engineer, a member of IEEE, and a member of The Rochester Engineering Society. He received his Bachelor of Science degree in Electrical Engineering from New York University, and has attended Boston University, and Massachusetts Institute of Technology.

The formulation of an integrated test plan defines the responsibilities and techniques for implementing, monitoring, and controlling the test and evaluation of a product. It provides a means of disseminating and utilizing data from all test sources for management control purposes.

The preparation of Reliability-Maintainability Program Plans identifies those activities and tasks to be performed throughout the program and the specifications and standards applicable to the program. It includes task descriptions.

"Reliability" is a time-related function that provides a measure of acceptability of performance for specific time periods in the future. It is a design parameter which can be *specified*, which can be *predicted* with a reasonable degree of success, and which can be *measured* by appropriate test programs. The degree of achievement depends very heavily upon the design engineer's knowledge of the system's operational environment, and and the consideration given in the design to factors such as the capabilities of the parts used in the system, the relative stresses on those parts, the adequacy of design margins applied in consideration of part tolerance build-up, short term environmental changes, permanent time degradation of part parameters, and the establishment of preventive maintenance procedures. Reliability prediction requires extensive knowledge and judgement relating to the many quality design, environmental, performance, and state-of-the-art considerations having an effect upon system operation.

"Maintainability" can also be specified, predicted and measured in a manner similar to reliability. It encompasses all the aspects of reliability and in addition, considers the procedures and test methods necessary to minimize system down time. This is accomplished by the appraisal of the physical design of equipment, maintenance philosophy, maintenance facilities and tools, and assumptions regarding the skill levels of maintenance personnel. Some of the techniques used by GRS to implement the goals of the R & M program plan are: Reliability Predictions, Apportionment-Allocation Analysis, Maintainability Predictions, Failure Mode & Effects Analysis (FMEA), Design Reviews (which includes Reliability Design Criteria, Piece Part Derating & Application, and Burn-in of Piece Parts to Reduce Early Failures) and Failure Reporting-Corrective Action Loop which are defined in the following paragraphs.

Reliability Predictions

Failure rates expressed in MTBF are calculated for each system, equipment or circuit. For high piece part population, failure probabilities from accepted sources are used. For low piece part population, failure rates are derived which reflect user experience, preferably in rapid transit or railroad application. Equipment and circuits which have higher calculated failure rates are identified, and trade-offs made to improve the *R*. In evaluating the expected performance of an equipment or circuit relative to its MTBF target, *R* engineers evaluate the influence of electrical, mechanical, thermal, and environmental stresses on part failure rates.

Each design group leader is given specific *R* goals for his equipment and the part his equipment will play in the overall system. He is also given MTBF design targets for his equipment. Design group leaders are responsible for controlling the *R* of their equipments and circuits in accordance with the assigned target MTBF's. In the process of analyzing the overall reliability problem, the reliability contribution of different equipment elements to the *R* goals are examined and target MTBF's assigned to the elements. The target MTBF for a particular equipment does not remain static. As more detailed design information and subcontractor designs become available, *R* requirements are reapportioned among equipment.

Apportionment is a Reliability technique used to allocate reasonable and feasible Reliability Numerical Goals. *R* Goals expressed as Mean Time Between Failures (MTBF) are calculated after a detailed analysis of the proposed equipment and discussion with the cognizant Design Engineers have been completed. Many factors are considered during this analysis; complexity of design, piece part population, state of the art needed to accomplish the equipment function, operating ambient temperatures, and percent of passive vs active elements.

Maintainability predictions

At the inception of design, all GRS personnel are given written *M* criteria that are applicable to maintenance of

FAILURE MODES AND EFFECTS ANALYSIS

PROGRAM _____ PREPARED BY _____

SYSTEM _____ DATE _____

MODULE _____

FAILURE MODE	EFFECT ON SYSTEM PERFORMANCE	CAUSE OF FAILURE	METHODS AND TECHNIQUES TO MINIMIZE OCCURENCE
MANNER IN WHICH A FAILURE MAY OCCUR.	IDENTIFICATION OF PARTIAL OR TOTAL DATA LOST AS A RESULT OF SPECIFIED FAILURE MODE.	SPECIFIC DESCRIPTION OF THE MECHANISMS CONTRIBUTING TO FAILURE.	● PIECE-PART SELECTION, DERATING AND SCREENING CONTROLS ● STRESS RELIEF ● PROCESS CONTROLS THAT MINIMIZE FAILURE DUE TO EFFECTS OF CLIMATIC & ENVIRONMENTAL CONTAMINATION ● PROCESS CONTROLS THAT MINIMIZE FAILURE DUE TO EFFECTS OF DYNAMIC ENVIRONMENTS ● WORKMANSHIP STANDARDS ● TEST PROGRAMS.

The "Failure Modes and Effects Analysis" form is used by the reliability engineer to analyze the possible causes of failures and to make recommendations that will minimize such occurrences.

the system in the operational environment. These criteria are revised as necessary, as the operational and maintenance philosophies are defined. A Mean Time To Restore (MTTR) target is established for each system element. The establishment of *M* targets and the prediction of an MTTR for each equipment element is coordinated with similar *R* activities, and will generally parallel the *R* approach.

The establishment of *M* targets involves the appraisal of the physical design of equipment, the maintenance philosophy, maintenance facilities and tools, and assumptions regarding the skill levels of maintenance personnel. Each equipment design is analyzed to estimate maintenance times expressed in MTTR hours.

Failure Mode and Effect Analysis is a design evaluation procedure which documents the potential failures and their effect in a system design, determines, by analysis, the logical consequence of each failure on system operation, and identifies failures critical to operational success. In addition to the general purposes of the Failure Mode Analysis, the analysis provides for both an insight into the total capabilities of the system design for reliability and maintainability, and the basis for assuring that the design provides a high level of system effectiveness.

Failure Mode and Effects Analysis (FMEA) provides:

a) The Design Engineer with a method of selecting a design with high reliability and maintainability during the early design phase.
b) An additional method to ensure that the failure modes and their effect on operational success of the system have been considered.
c) A basis for quantitative reliability analysis.
d) A documentation to aid in analysis of field failures and/or consideration of design changes.
e) A basis for establishing corrective action priorities.
f) The methods to preclude failure.

Design reviews

Organized design reviews bring together the designers and representatives of Reliability and Maintainability, Quality Control, and Manufacturing Engineering, plus other specialists as appropriate, to submit new designs to a knowledgeable scrutiny to predetermined critical schedule points. Such reviews contribute significantly to the development of mature, reliable, quality designs. Periodic design reviews are held, at which time the Program Reliability Engineer is a key participant. For a design review to be effective, the subject matter of the review must be specific. Initial design reviews consider such matters as: Concepts, Specifications, Component Selection, Standardization and Derating, System Restraints, Reliability Goals, Environments, Duty Cycles, and Longevity.

Although formal design reviews may result in design changes, many other changes occur during the course of an equipment or system design. Unlike a formal design review, which is a periodic device, the review of design changes requires a constant surveillance of all engineering activity for *R* & *M* impact. Each proposed design change is examined to assess its impact upon equipment and system failure rates. A proposed change is not implemented without an evaluation of *R* & *M* impact and specific *R* & *M* approval. This procedure permits trade-offs at a convenient and economical design level.

A failure reporting system has been developed at GRS to collect data on all failures in product test areas and in the field. The failure reporting system includes analyses of failed parts (when required), as well as individual and statistical failure studies. So that adequate and meaningful data are collected, *R* personnel participate in preparing failure reports and in investigating the conditions surrounding the failure. It is the *R* & *M* policy that upon occurrence of a failure, an investigation be made as to symptom and cause of failure, and a failure report be prepared. Information such as the following is included in failure reports: Reporting activity and name of reporting individual, Date of report, Date of failure, Geographical location of failure, Reference or circuit designation and name of failed item, Serial number, Failure symptoms and

effects, Operating time of failed item, Operating time of equipment, Previous history, Corrective action taken, Repair time, and Disposition of failed item.

To ensure the effort spent acquiring and analyzing failure data is productive, a corrective action system is required to close the loop between recognizing the problem and implementing the solution. Each problem brought to light is carried as an open item until performance data demonstrates that a solution has been effected. Field failures are given priority attention. Action to correct a failed part problem is requested by a written Discrepancy Report (DR). Polaroid photographs are attached to a DR as appropriate. A suspense file of DR's is maintained by the Program Reliability Manager. The original of each DR is returned to the customer with a written statement of the action taken. This provides a single document record of the problem and the solution.

Specifying R & M requirements

With the foregoing in mind, it is essential that an authority or purchaser of transportation controls specify the requirements that will meet his individual needs and assure maximum R&M effort from the contractor. R&M performance criteria should therefore be an integral part of the contract. A typical example of how these requirements are defined follows:

PURPOSE

This section establishes the requirements for a reliability & maintainability (R & M) program, and provides guidelines for the preparation and implementation of a R & M program plan.

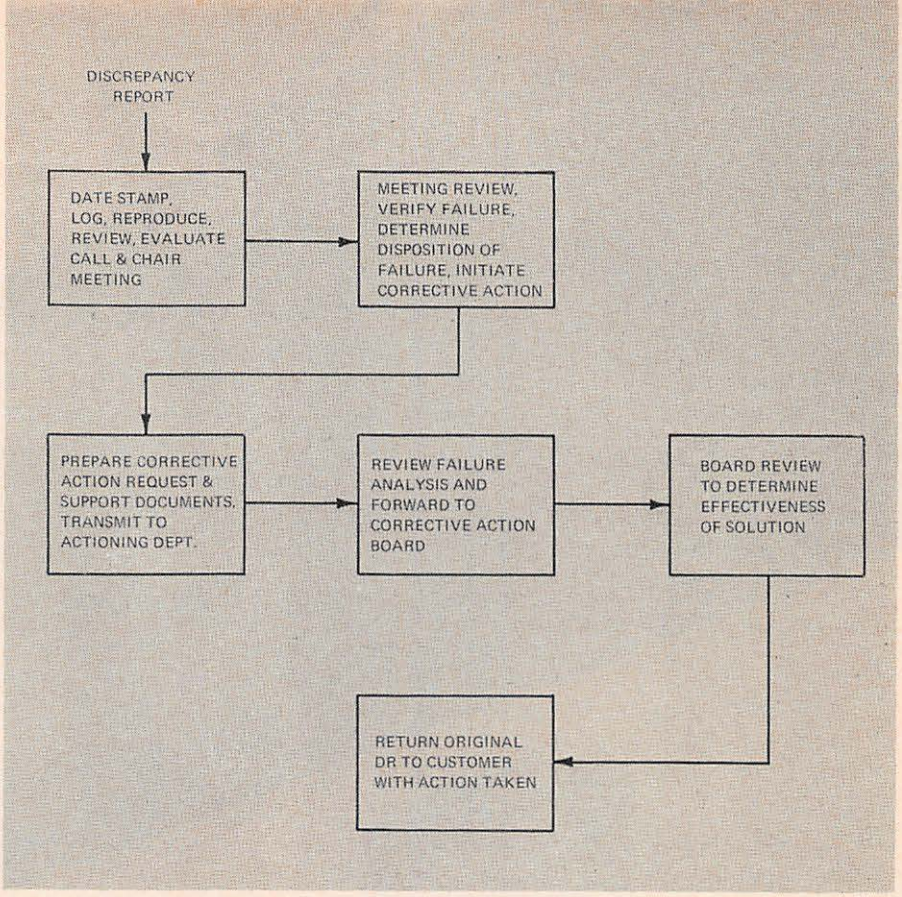
GENERAL REQUIREMENTS

Reliability and Maintainability Program

The contractor shall establish and maintain an effective *R & M* program that is planned, integrated, and developed in conjunction with other design, quality control, and production functions to permit the most economical achievement of overall program objectives. The reliability program shall include the management/technical resources, plans, procedures, schedule, and controls for the work needed to assure achievement of reliability requirements.

Quantitative Requirements

The system's overall *R & M*, MTBF and MTTR requirements and objectives shall be as specified in the table of reliability goals. Quantitative hardware requirements for all major subsystems and equipments shall be included in appropriate sections of the system specifications. The values


DISCREPANCY REPORT
DATE STAMP, LOG, REPRODUCE, REVIEW, EVALUATE CALL & CHAIR MEETING
MEETING REVIEW, VERIFY FAILURE, DETERMINE DISPOSITION OF FAILURE, INITIATE CORRECTIVE ACTION
PREPARE CORRECTIVE ACTION REQUEST & SUPPORT DOCUMENTS, TRANSMIT TO ACTIONING DEPT.
REVIEW FAILURE ANALYSIS AND FORWARD TO CORRECTIVE ACTION BOARD
BOARD REVIEW TO DETERMINE EFFECTIVENESS OF SOLUTION
RETURN ORIGINAL DR TO CUSTOMER WITH ACTION TAKEN

The discrepancy reporting procedure is illustrated by this flow diagram showing the failure reporting and correction action loop technique.

DISCREPANCY REPORT

NO. _____

YOUR NAME _____ DATE _____

CAR NUMBER OF SPECIFIC LOCATION _____

FUNCTION AFFECTED _____

FAILED ITEM NAME _____ SERIAL NO. _____

FAILED ITEM PART NUMBER _____ QUANTITY _____

DATE PLACED IN SERVICE _____

DATE OF FAILURE _____ TIME _____

PARTS RETURNED ☐ REPAIRED IN FIELD ☐

TIME TO RESTORE _____

LOCATION: TOWER OR
CARBORNE ☐ WAYSIDE ☐ OFFICE ☐ YARD ☐

HOW FOUND: VISUAL ☐ OPERATOR REPORT ☐ NORMAL MAINTENANCE ☐
ALARM ☐

POSSIBLE CAUSE OF TROUBLE (IF KNOWN): WORKMANSHIP ☐ DEFECTIVE PART ☐
MAINTENANCE/INSTALLATION ☐ SECONDARY CAUSE ☐
i.e. LIGHTNING etc.
FAILURE OF OTHER
PRODUCTS OR DEVICES

DESCRIPTION OF TROUBLE OR SYMPTOM:

REMARKS OR COMMENTS:

A typical GRS discrepancy reporting form used with reporting procedure.

Innovative design created in the Brooklyn Bridge
a timeless structure as serviceable today as when it was opened
ninety years ago. Equally innovative designs maintain
Kerite's unique reputation for insulated electrical cables
that stand the test of time under the most demanding service
and installation conditions. Specify Kerite...the cable that lasts...
and lasts...and lasts...

MEMBER RPI

The Kerite Company • Principal Offices: Boston; Chicago; New York; Philadelphia; San Francisco; and Seymour, Connecticut • Sales Representation throughout the United States. A subsidiary of Harvey Hubbell Incorporated.

Kerite

ESTIMATED MEAN TIME TO RESTORE

PROGRAM A

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL
ROCHESTER, NEW YORK 14602

EQUIPMENT MARKERS (ACTIVE PORTION)

DATE 6 MAY 1974

ESTIMATED BY JOHN R. OLESON

SHEET 1 OF 1

REPLACEMENT UNIT	CURRENT PREDICTED FAILURE RATE	AVERAGE TIME TO PERFORM MAINTENANCE TASKS (M) (In Minutes)					** M_t	λM_t
		PINPOINT	REMOVE	REPLACE	*ADJUST	VERIFICATION TEST		
MARKER RESISTOR MODULE BD	.52	12	4	4	—	10	(30) .51	.27
MARKER CONTROL	31.31	15	4	4		10	(33) .56	17.53
4 STATE MARKER SYSTEM	1.21	35	5	15		10	(65) 1.11	1.34
MARKER COIL	.71	40	5	15		10	(70) 1.19	.85
$\Sigma\lambda$	33.75						$\Sigma\lambda M_t$	19.99

*When Applicable
**(M) (.0166) = M_t Hours

$$MTTR = \frac{\Sigma(\lambda M_t)}{\Sigma\lambda} = \frac{19.99}{33.75} = .59 \text{ Hours}$$

Form 1077

An "Estimated Mean Time to Restore" form is used to predict time required to perform repair of the unit.

not established by the purchasing authority shall be established by the system or equipment contractor at a contractually specified control point prior to detail design. The established values shall be subject to reallocation as the functional complexity and piece part population of the system are defined.

Reliability & Maintainability Program Plan

The contractor's proposed program plan shall describe how he plans to conduct the program to meet the requirements of the "request for proposal" and the "statement of work", in order to comply with applicable reliability program elements listed below in the detailed requirements. The plan shall be submitted as a separate and complete entity within the contractor's proposal. The reliability program plan, as approved by the purchasing authority, will be incorporated into the contract.

DETAILED REQUIREMENTS

R & M Organization

The program shall (1) identify the organizational elements and the key personnel responsible for managing the overall program, and (2) clearly define the related responsibilities and functions, including both policy and action. It shall stipulate the authority delegated to the organizations to enforce its policies. The relationships between line, service, staff, and policy organizations shall be identified.

Management and Control

Management Tasks

The plan shall include (1) a detailed listing and description of each task, (2) procedures for recording the status of actions to resolve the problems, (3) method by which the *R* & *M* requirements are disseminated to designers and associated personnel, and (4) provisions for *R* & *M* indoctrination and training in connection with this project.

Interface Compatibility

The program shall be coordinated with other interfacing efforts (such as listed below) to assure an integrated and effective contractual effort:

a. Maintenance engineering
b. Training
c. Quality assurance and quality control
d. Standards
e. System engineering
f. Configuration management
g. Integrated logistic support

Subcontractor and Supplier R & M Programs

The program plan shall stipulate

GRS TRACK QUALITY METER

MEASURES TRACK BALLAST RESISTANCE QUICKLY AND EASILY

The GRS track quality meter can quickly determine ballast resistance thus cut cost and save time in maintenance and installation of track circuits. Simply clamp the track leads across the rails, position the switches, and adjust the BALANCE control – the BALANCE control digital reading can be translated directly into ballast resistance using the calibrated graph. IT'S THAT EASY!

Only 2 track connections necessary for ballast resistance and track current measurements.

And with the accessory current probe, the meter can just as easily determine track uniformity, low resistance pockets (as may occur at highway crossings), and switch rod insulation and insulated joint efficiencies.

Solid-state circuits, a sturdy light-weight fiber glass carrying case, and its own battery pack make the GRS track quality meter a durable instrument suited for field use.

For more information, write for GRS Catalog 92-6.

GENERAL RAILWAY SIGNAL COMPANY

A UNIT OF GENERAL SIGNAL

ROCHESTER NEW YORK 14602

ATLANTA BOSTON CHICAGO MONTREAL NEW YORK OAKLAND ST LOUIS ST PAUL WASHINGTON

3596

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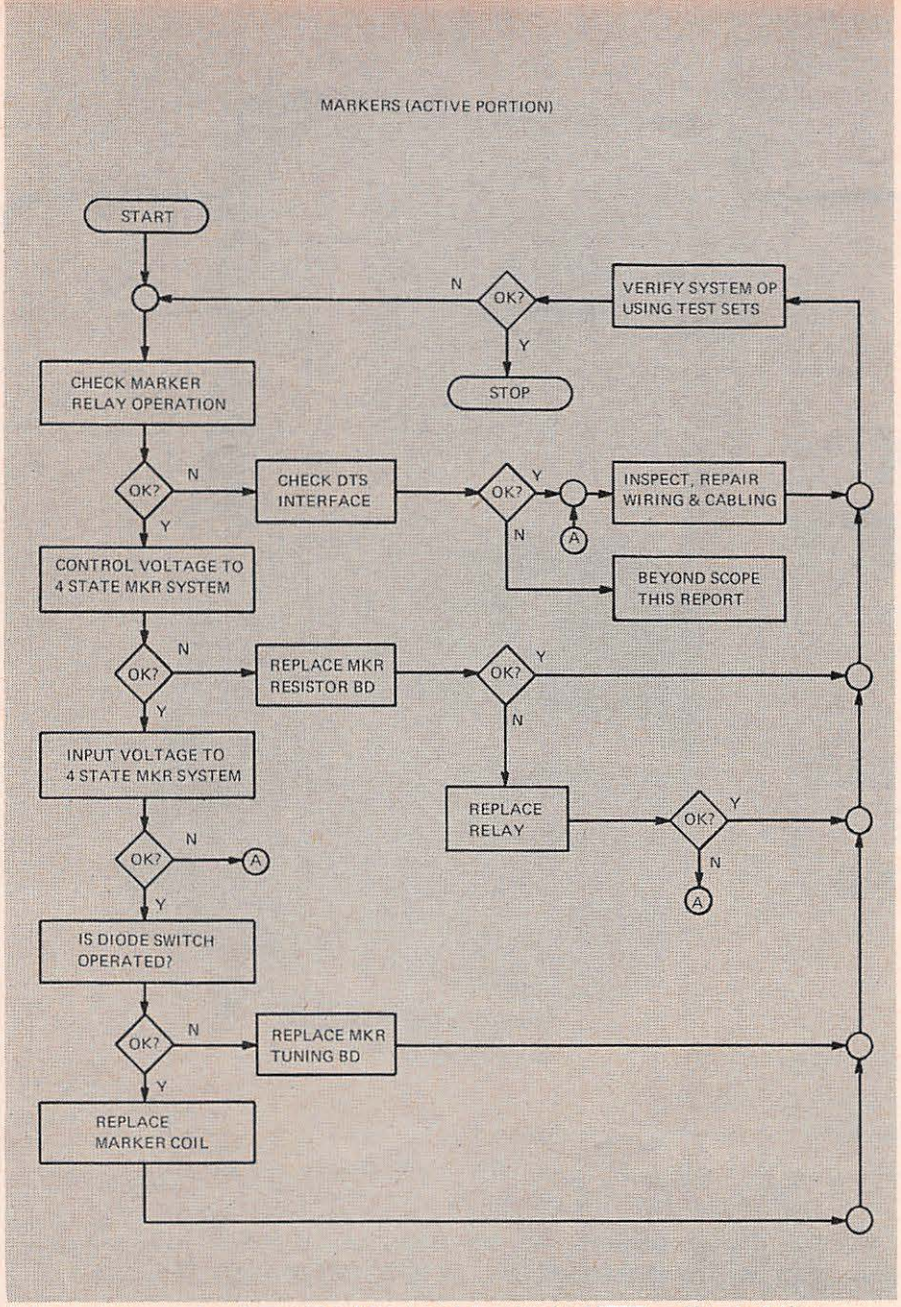


A flow diagram showing procedure used to obtain MTTR estimated time.

methods for assuring that the subcontractor's and supplier's R & M efforts are consistent with overall system requirements, and that provisions are made for source selection of subcontractor and supplier, and surveillance of their activities.

Program Review

The R & M program shall be planned and scheduled to permit the contractor and the purchasing authority to review its status, including results achieved, at preplanned or scheduled checkpoints. This formal review and assessment shall be conducted at major program points (in conjunction with system program reviews). As the program develops, reliability progress shall be assessed, and reallocation evaluated by the use of information such as predictions of reliability and results of reliability design reviews and tests. The purchasing authority shall be notified at least 10 days prior to each contractually scheduled formal program review to permit possible participation by the procuring activity.

RELIABILITY DESIGN AND EVALUATION

Design Techniques

The use of electrical stress derating, stress-strength analysis, and other reliability oriented design techniques shall be practiced in designing equipment, especially where vital items or potentially critical failure modes are encountered.

Reliability Analysis

A reliability analysis of the system/equipment shall be initiated at the start of the contractual effort. Coverage should include, but not necessarily be limited to, the following paragraphs.

Functional Model

a. Identify hardware system elements required for the execution and support of each function.
b. Create model (s) on this functional basis.

Reliability Apportionment/Prediction

a. Determine the reliability of hardware items and other system elements executing or supporting each function/equipment.
b. Reliability estimates and predictions shall be made relating to the mathematical model such as those contained in MIL-HDBK-217. Data furnished by the Piece Part manufacturer on known or estimated values of reliability shall be used as applicable in the contractor's judgement.

Model Outputs

a. Compare model outputs with the initial requirements.
b. Identify reliability problem areas and recommend corrective action.
c. Reiterate model as necessary.

Model Updating

a. Assure that proposed design and other relevant changes are reflected in the model and the effects on system/equipment reliability are brought to the attention of top management.

Parts Selection

A preferred parts list for design use shall be established. Parts application criteria shall be established to control selection of parts, and piece part screening techniques defined. The best available estimate of a reliability index under the applicable stress levels shall be assigned to each part number, component, or subassembly. In using existing data, the risk and limitations of extrapolating part performance data obtained at one set of environments and/or stress levels shall be recognized.

Failure Mode and Effect Analysis (FMEA)

The primary purpose of FMEA is to identify potential system weaknesses. Each potential failure shall be evaluated to determine its effect on equipment accomplishment. Vital circuit failures shall be further investigated as to failure mode to determine design improvements required to minimize failure causes. The FMEA should be planned as a continuing effort to give design guidance and to

If you approve of us, we'll save you money.

Every railroad in the country used to buy the same two-way radios until a major line tried our RF Series 1500 VHF model.

It does the job, and it also costs less than radios the railroad had been using.

It operates on 148-174 MHz, gives undistorted transmission at 25 watts with lower battery drain and cooler operation. The final amplifier is protected from damage caused by improper or defective antenna, voltage variations and ambient temperatures.

Reception is free from interference. High sensitivity increases operating range by receiving lower signals in weak fringe areas. Positive-acting squelch so radio is silent until channel becomes active. Vibration has no effect on transmission or reception.

The Series 4500 UHF 2-way radio operates on 450-470 MHz and 15 or 25 watts output power. Solid-state throughout. Interference-free reception. Audio output of 5 watts assures reception even under the noisiest cab condition. Single or half duplex modes, with up to 12 channels.

We also manufacture a complete line of hand-held portables in VHF/UHF ranges. These Porta Phones are light, compact and built to take rugged railroad use. Choice of power sources with multi-channel capability. Optional features available.

For literature, write:
RF Communications, Harris Corporation, National Marketing, 1680 University Avenue, Rochester, N.Y. 14610.

RF Communications Division

HARRIS
COMMUNICATIONS AND INFORMATION HANDLING

DOC and GSA approved.

Corrective actions must be taken on a timely basis to prevent repetition of failures.

provide data for consideration in each design review.

Design Reviews

Reviews shall be made at appropriate stages of development and production to evaluate achievement of the reliability requirements. The planned reviews should include, to the extent applicable but not necessarily limited to, (1) current reliability estimates and achievements for each mode of operation, as derived from reliability analyses or test(s), (2) potential design or production (derived from reliability analyses) problem areas, and control measures necessary to preserve the inherent reliability, (3) failure mode(s) and effect(s) analyses, (4) corrective action on reliability items, (5) effects of engineering decisions, changes and trade-offs upon reliability achievements, potential and growth, within the functional model framework, (6) status of subcontractor and supplier reliability programs, and (7) status of previously approved design review actions.

FAILURE DATA

Failure Data Collection, Analysis, and Corrective Action

The contractor must have a closed loop system for collecting, analyzing, and recording all failures that occur during in-plant tests and those that occur at test sites or installation sites prior to turnover to the procuring agency. The contractor shall describe his proposed system for initiating failure reports, the analysis of failures, and feedback of corrective action as a part of the program plan. The analysis and recording of a failure shall differentiate between, but not be restricted to, those due to human error in designing, manufacturing, handling, transporting, storing, maintaining, and operating the equipment. Elapsed time indicators or their equivalents shall be utilized to report accumulated operating time or cycles on major system components. The contractor failure reporting system shall include provisions to assure that effective corrective actions are taken on a timely basis to reduce or prevent repetition of the failures. The contractor's program shall include follow-up audit to review all open reports, analyses, and corrective action suspense dates and reporting of all delinquencies to management.

Failure Summaries

The contractor shall submit failure report summaries.

STATUS REPORT

Within ninety days after the award of the contract, a preliminary reliability study shall be made by the contractor. The report format shall include the requirements of sections concerning the Functional Model, Reliability Apportionment/Prediction and Prediction of Maintainability Parameter Values. The report will be updated and reissued every sixty days.

MAINTAINABILITY DESIGN & EVALUATION

Maintainability Design Criteria

From the inception of the effort related to the request for proposal or contract, the contractor shall establish and periodically update detailed maintainability design criteria determined from the repetitive system/equipment maintainability analysis. These criteria shall be implemented by maintainability design guidelines. Appropriate consideration of maintainability design criteria shall be reflected in design concept reviews, item selection, design reviews, and design trade-offs. The following are some of the maintainability design guidelines which should be considered for incorporation into the design.

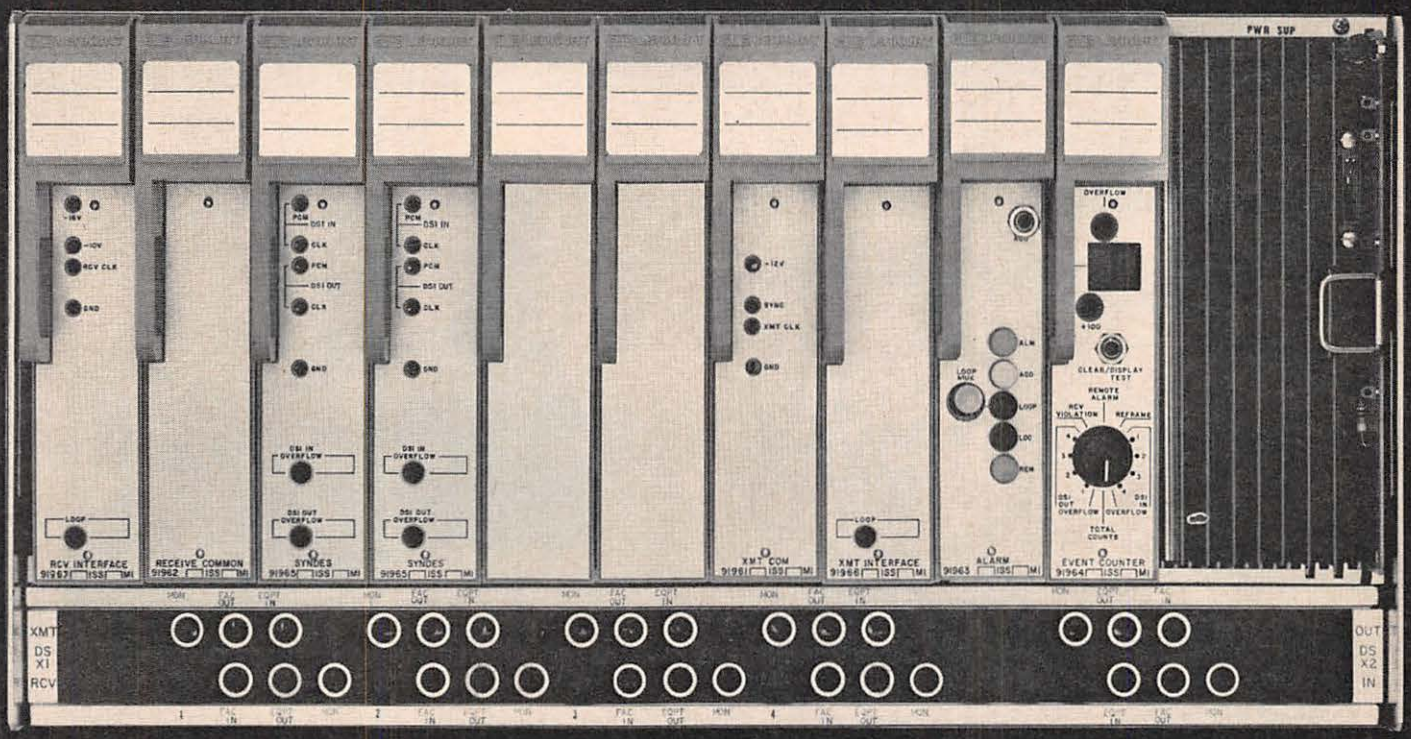
a. Reduce the complexity of maintenance by:
   (1) Providing adequate accessibility, work space, and work clearance.
   (2) Limiting the number and variety of tools, accessories, and support equipment.
   (3) Insuring compatibility among system equipment and facilities.
b. Reduce the need for and frequency of design-dictated maintenance activities by using:
   (1) Components which require little or no preventative maintenace.
   (2) Tolerances which allow for use and wear throughout life.
   (3) Adequate corrosion prevention/control features.
c. Reduce maintenance downtime by designing for:
   (1) Rapid and positive detection of malfunction or degradation by the use of fault indicators.
   (2) Rapid and positive localization of malfunctions to the repair level for which skills, spares, and test equipment are planned.
   (3) Ease of fault correction.
   (4) Rapid and positive adjustment and calibration.
   (5) Rapid and positive verification of correction.
d. Reduce design-dictated maintenance costs by limiting:
   (1) The need for specialized maintenance tools, support equipment, and facilities.
e. Limit maintenance personnel requirements by applying human engineering principles such as:
   (1) Identification and accessibility of parts, test points, adjustments and connections.
   (2) Easy handling, mobility, transportability and storability.
   (3) Logically sequenced maintenance tasks.
f. Reduce the potential for maintenance error by designing to eliminate:
   (1) The possibility of incorrect connection/assembly/installation.
   (2) Dirty, awkward, and tedious job elements.
   (3) Ambiguity in maintenance labeling, coding, and technical data.

Incorporate and Enforce Maintainability Requirements In Subcontractor and Vendor Specifications

Based on the results of maintainability analysis, the contractor shall include appropriate quantitative maintainability requirements in specifications for subcontractor and vendor items procured.

Predict Maintainability Parameter Values

The contractor shall predict maintainability values for the system/equipment. The prediction technique used shall be approved by the purchasing authority. The prediction technique shall estimate quantitatively the maintainability system/equipment parameter values for the planned design configuration. The quantitative estimates shall be used to judge the adequacy of the proposed design to meet the maintainability quantitative requirements and identify design features requiring corrective action.



This is what it takes to get PCM on radio.

Our new 9120A Digital Multiplexer.

Whether you are establishing a new end-to-end microwave route or only want to transfer PCM cable routes to radio right out of the T1 line repeater . . . then back again, our digital multiplexer lets you do it in a way that wasn't even possible not long ago.

Now problem areas like mountains, lakes, streams and swamps aren't problems any more. Also simpler and less costly are subscriber services to remote resorts and offshore islands, alternate routes, and replacement of old open-wire lines.

Our new 9120A Digital Multiplexer takes two 24-channel T1 bit streams derived from either channel banks or repeatered lines and combines them. GTE Lenkurt's patented modified Duobinary technique cuts the bandwidth requirement of the combined bit stream in half so that the FCC type-accepted radio only needs about 3.5 MHz of rf spectrum for 48 voice or data channels. Cross polarization of the antenna gives you 96 channels per microwave frequency.

Our digital multiplexer is not like any other. It leaves the frequency band below 8 KHz for order wire, alarm and tone transmission. No other multiplexer gives you that feature.

Something else you can't get anywhere else is GTE Lenkurt's capability to deliver *every* component of the complete system. We have it all: PCM channel bank, PCM digital multiplexer and microwave radio unit.

Which is probably no surprise to anybody. Since we're in the communications business to stay, we build *systems* — not just components. You can see how that gives us a clearer understanding of your problems. And how that, in turn, leads to building even better systems.

For more information, write: GTE Lenkurt, Dept. C134, 1105 County Road, San Carlos, CA 94070.

Typical Equipment Arrangement—78F2 2-GHz Microwave Radio, 53C Order Wire, 9120A Digital Multiplexer, and two 24-channel 9002A PCM Channel Banks. Overall Height: 5'10".

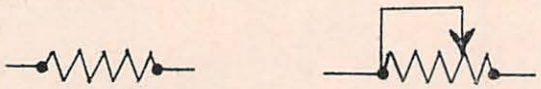
GTE LENKURT

Circle 9 on Reader Service Card.

1. Title: RESISTOR

2. Definition:
A resistor is a device that reduces the flow of current in an electrical circuit.

3. Symbol:



4. Description:
A resistor may be a mass of material, such as carbon, with connecting wires at both ends, Fig. 1.

A resistor may be a length of wire wound around an insulator, Fig. 2.

The wirewound resistors, when used in signal circuits, are often of the variable type. A variable resistor has an adjustable contact mounted on a metal slide bar attached to the binding posts of the unit, Fig. 3. One end of the slide bar is insulated from the binding post but the other end is not. When the contact is moved away from the insulated end, the resistance is increased, Fig. 4a. When the contact is moved toward the insulated end, the resistance is decreased, Fig. 4b.

Fig. 1

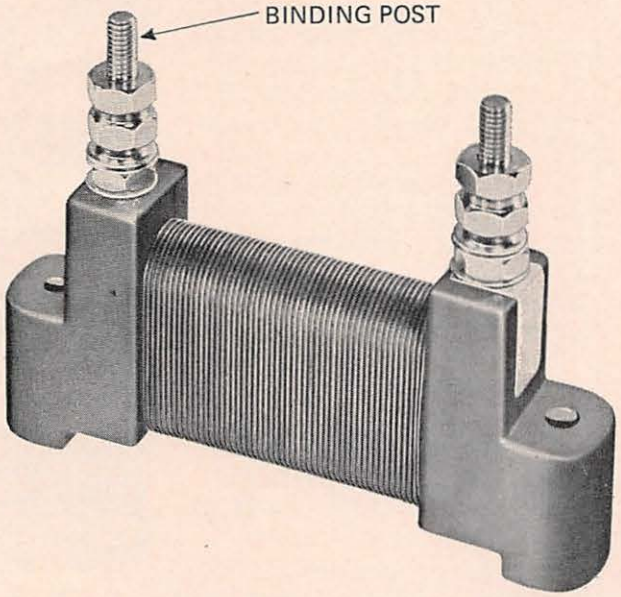


Fig. 2

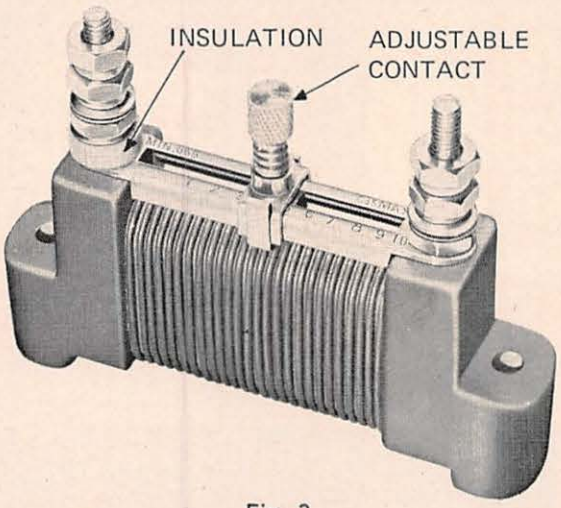


Fig. 3

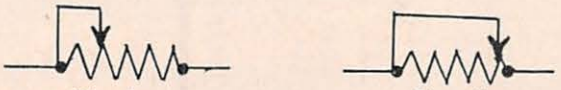


Fig. 4a Fig. 4b

5. Purpose & Application:
The primary use of resistors in signal circuits is that of limiting current. In this application, a resistor reduces the current to the value required by the load. For example, in Fig. 5a, a lamp is connected to a battery. In this example, the current flowing from the battery to the lamp may be too high. In Fig. 5b, a resistor is inserted in series with the lamp to reduce the current to the required value.

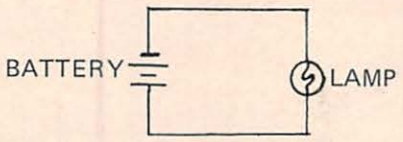


Fig. 5a

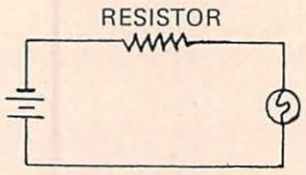
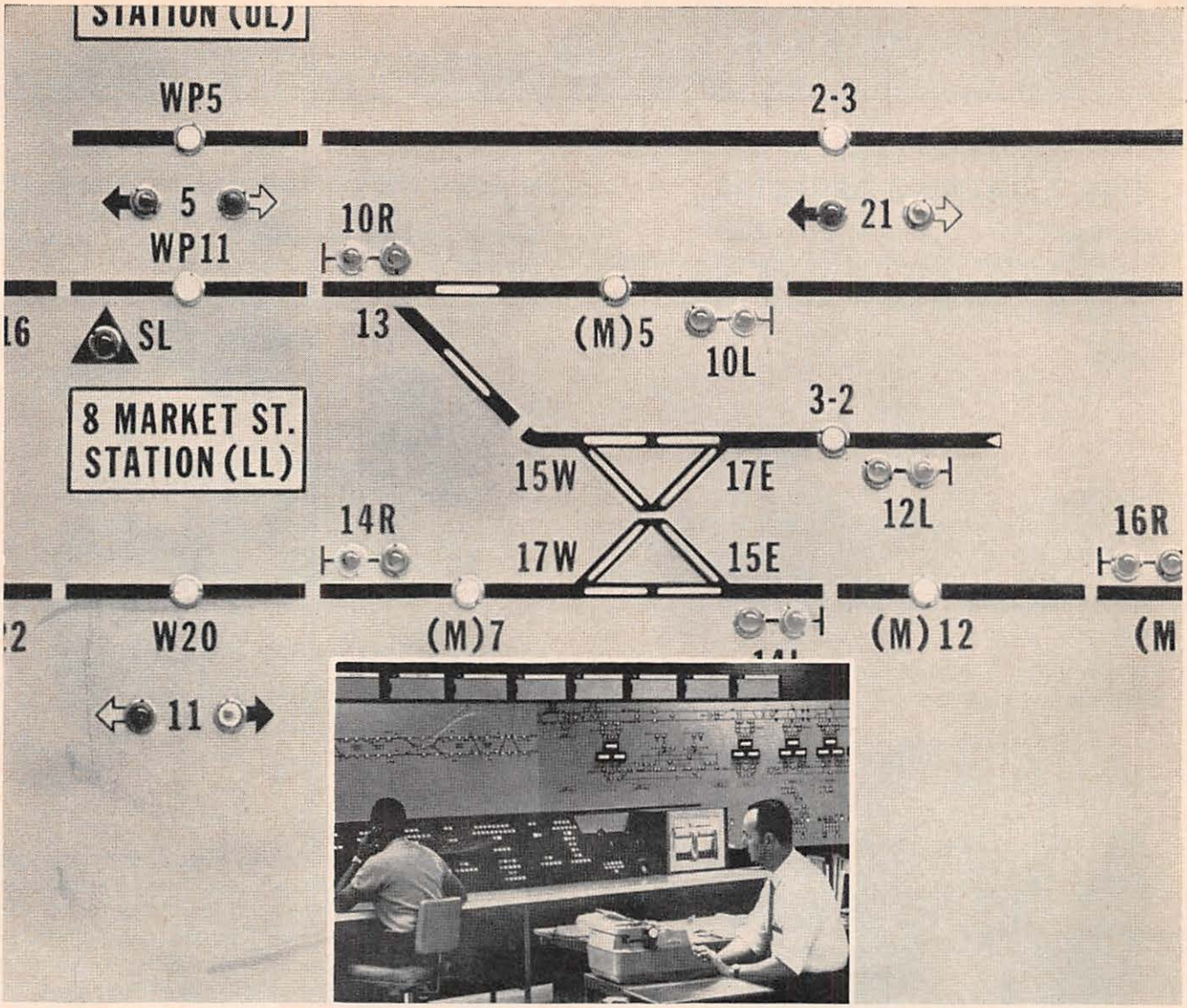


Fig. 5b

6. General Information:
Many railroads have instructions outlining installation, maintenance, and inspection procedures with regard to resistors. It is most important that you become familiar with your company's requirements.

7. Detailed Operation:
None.



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Circle 10 on Reader Service Card.

1. Title: LIGHTNING ARRESTER

2. Definition:
A lightning arrester is a device for protecting circuits and apparatus against lightning or other abnormal voltage rises of short duration.

3. Symbol:

4. Description:
The main component of a lightning arrester of the type described here is the spark gap. This gap is designed to permit a spark to jump across it when the voltage exceeds a specified value. Arresters may have one or more gaps.

Fig. 1 and Fig. 2 illustrate arresters with two binding posts and one spark gap.

Fig. 1

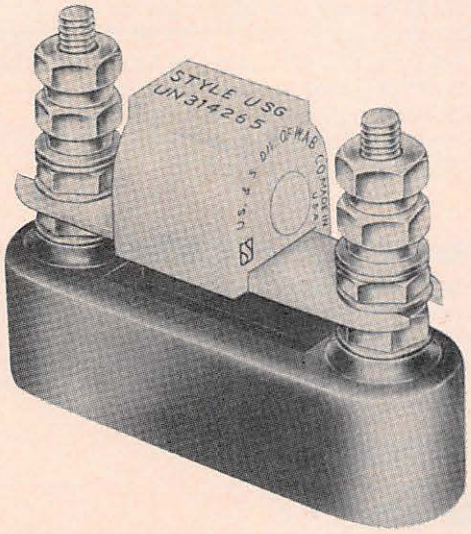

Fig. 2

An arrester of the spark gap type with 3 binding posts and 2 spark gaps is illustrated in Fig. 3. The 2 outside binding posts are connected by a wire in the base of the arrester.

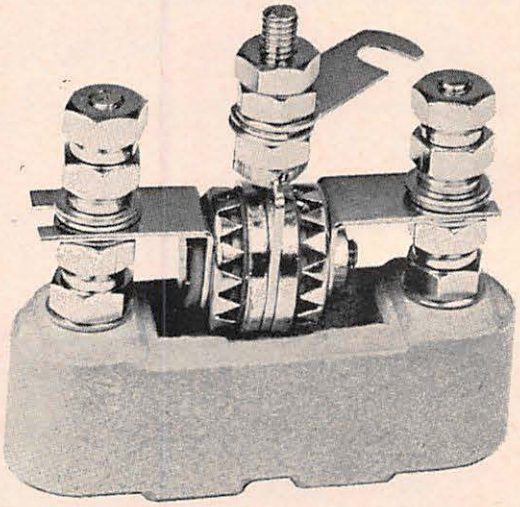

Fig. 3

5. Purpose and application:
Figs. 1, 2, and 3 illustrate only three of the many spark gap type arresters manufactured. They all perform the same function. Lightning or other voltage rises of short duration (transients) often have the capability of destroying signal equipment or disrupting its operation. Lightning arresters protect the signal equipment from these surges. The arrester is built so that it allows normal voltage and current inputs to the signal equipment, but diverts all surges once the breakdown voltage is exceeded.

Lightning arresters may be connected as shown in Figs. 4, 5, and 6.

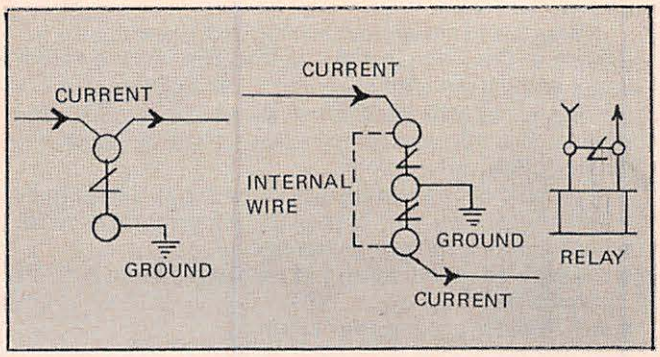

Fig. 4

Fig. 5

Fig. 6

6. General Information
It is most important that you become familiar with your company's instructions and requirements.

7. Detailed Operation:
None.

Problems/ Solutions

Question:

In reference to a statement made in AAR Signal Training Bulletin B-1 appearing on page 14 of RSC May, 1974: "The last U.S. manufacturer of the renewable carbon cell battery will discontinue production of this battery as of August 1, 1974."

Why???

M. Peacock
King of Prussia, Pa.

Answer:

This decision was based solely on the fact that the market for renewable carbon cells has been declining rapidly in recent years and the volume is now so low that these cells could not continue to be manufactured profitably. There were no technical or product problems involved in this decision.

For further clarification, following is part of an explanatory letter sent by Mr. A. W. Frank, Vice President-Sales, McGraw-Edison Co., to all carbon cell customers: "In recent years, our line of renewable carbon batteries has been faced with a steadily and sharply declining market. This has occurred despite the fact that we are now the only U.S. battery company to manufacture this type of cell.

"Research studies have conclusively proved that there are no market areas—other than railway signaling—where renewable carbon cells could be profitably promoted and sold. The majority of our railway signaling customers have now switched over to other types of batteries—notably the non-renewable Edison Carbonaire Batteries—for installations formerly using either copper-oxide or renewable carbon cells. One major reason for this switch is the maintenance labor saving that Carbonaire batteries make possible.

"The present low sales volume, coupled with prospects for still further declines in the near future, have made it necessary for us to discontinue the manufacture of all types of renewable carbon cells. These are the A-500, A-1000 and RE-1000 cells and renewals. This will take effect on August 1, 1974 . . ."

W. A. Melroy
Director of Advertising
McGraw-Edison Co.
Edison Battery Division

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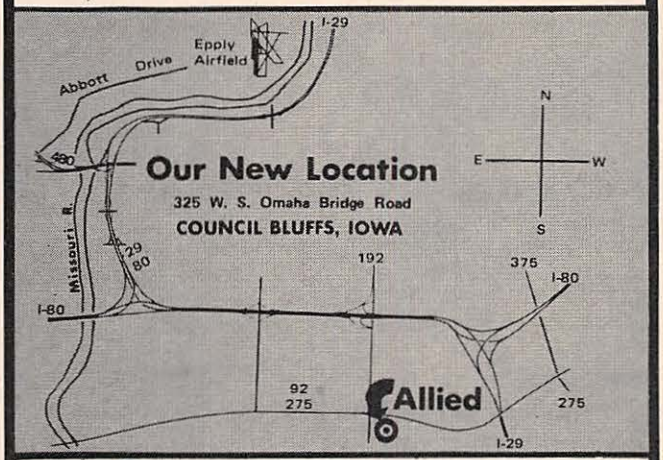

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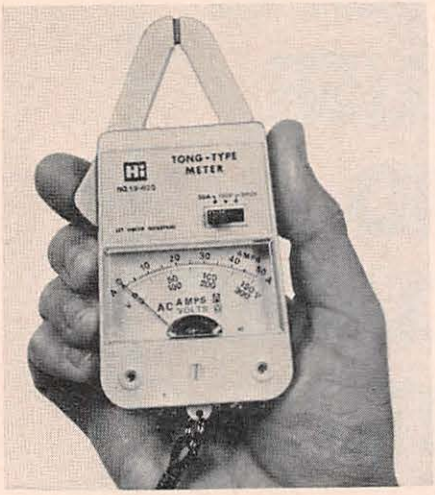
Circle 11 on Reader Service Card.

Product News

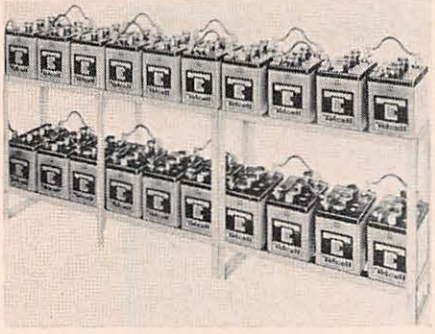


Tong-type meter is compact

A new compact, junior size "Tong-Type" meter is only 2½ in. by 1⅜ in. by 5 in. long. The meter has three scales for measuring AC current from 0 to 50 amps, 0 to 150 volts and 0 to 300 volts. Tongs are big enough to close around conductors up to ⅝ in. in diameter.

Other features include: Meter movement protection, probe mount on back of case, two test probes with 42-in.-long leads, hand strap and carrying case. *Holub Industries.*

Circle 101 on reader service card



Standby power system comes as a complete package

A ready-to-go standby energy system that eliminates the need for special on-site engineering is available for a broad number of applications. The Tel/Cell System TC 120-100 includes twenty 6-volt batteries, ready for mounting on a pair of two-tier racks that come with the package. All connecting cables are also furnished, along with a hydrometer, thermometer, filler syringe and installation, operating and maintenance instructions.

The system is designed to provide long-life standby service for telephone, CATV, microwave, data processing and other telecommunications applications. The batteries are protected from vibrations and shocks by tough, injection molded polypropylene covers and cases and molded side supports that lock cell elements tightly in position. Large electrolyte reservoirs equip them for supplying power over prolonged periods with minimum need for refilling or other maintenance. *Globe-Union Inc.*

Circle 102 on reader service card

Fault selective relay is for electric transit

A new Fault Selective Relay (FSR) is designed to identify faults within the electric power system of an electric rapid-transit system. The electric operating conditions of a rapid transit system vary greatly with train lengths, loading, feeder voltage etc. In the event of a fault, power to the malfunctioning section must be removed for personnel safety and to prevent equipment damage. The FSR is said to meet these requirements. It monitors the DC feeder current and discriminates between a true fault and normal operating conditions. In the event of a fault, the FSR opens the AC breakers to interrupt the fault current.

The FSR consists of a current transient sensor, a fault discriminator and a fast action relay. The current transient sensor is a non-contact assembly which encircles the DC bus. The fault discriminator is the transient selective circuitry. The high speed relay opens the AC breakers when the fault is detected.

The FSR responds to the positive rate of current rise associated with a fault. It ignores the absolute current level and normal operating transients. It will allow overcurrents without triggering. This prevents spurious power

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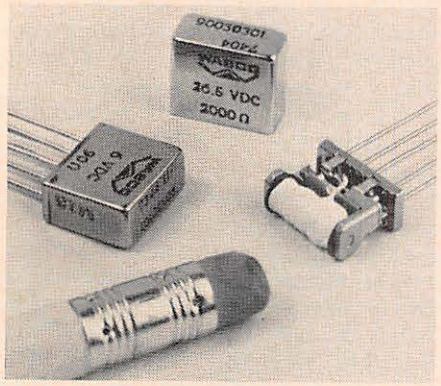
removal for short term overloads which will not cause damage. Absolute power protection is left entirely to the AC breakers.

The FSR is designed to operate from a 100 volt battery-charger type supply. Accidental power interruptions are said not to affect the protection provided by the FSR. *Halmar Electronics, Inc.*

Circle 103 on reader service card



Microminiature relays have many applications

A new family of general purpose microminiature rotary relays, featuring 0.1-inch grid-spaced terminals to facilitate high density printed circuit board packaging, has been announced by the WABCO Aerospace Department, Pittsburgh, Pa.

The one-sixth-size crystal case relay family includes two SPDT members, designated Models 900 and 930, and two DPDT members, designated Models 901 and 931. All are hermetically sealed, high reliability relays designed to meet or exceed applicable performance requirements of MIL-R-5757. The new relays are available in a wide range of coil voltages, including 6, 12, 26.5, 48 and 76 volts.

The devices have an operating temperature range from −65C to +125C, and they are said to withstand 100G shock for 6 ms. Contact rating is low level dry circuit applications to one amp maximum, contact resistance at rated current is 0.05 ohm maximum, and mechanical life expectancy at rated load ranges from 100,000 to 150,000 operations. *WABCO Aerospace Department.*

Circle 104 on reader service card

ACI labels get teflon coating

A new ACI module has been developed that is said to incorporate all of the requirements for an IST (Improved Surface Treatment) module as specified for use by the AAR.

This module features a Teflon surface coating which promotes better cleaning and resistance to abrasion and chemicals. Because of a unique bonding technique the IST is also said to withstand temperatures up to 350 degrees F. The module is supplied with a premask so that no changes in application procedures are required. *Info Inc.*

Circle 105 on reader service card

New facsimile terminal features complete automation

The dex 4100 automated systems facsimile transceiver is designed for high and medium volume communications with emphasis on systems applications. It features complete automation, high speed, high resolution and high reliability. The dex 4100 incorporates flat bed scanning and a stack loader that can automatically transmit a maximum of 100 documents of varying sizes and thicknesses, including documents, in continuous format. The unit is capable of receiving up to 500 eleven-inch copies without an operator in attendance and will automatically cut them in various lengths or continuous, and stack them automatically.

The dex 4100 operates over standard telephone lines with connection made through the telephone company's Auto-

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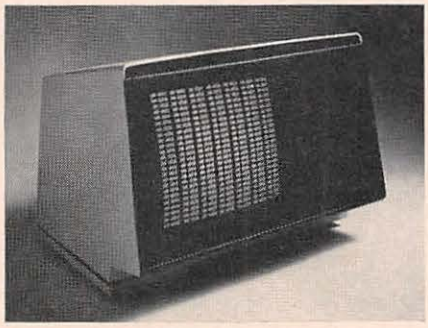
matic Data Access Arrangement. *Graphic Sciences Inc.*

Circle 106 on reader service card



Read-only CRT uses "building-block" design

The Design III display terminal is a low cost, multi-character, silent alternative to gaseous indicator tubes, LED's, liquid crystal displays and read-only TTY's in minicomputer, microcomputer, and computer peripheral applications. The Design III concept features a 14 in. diagonal CRT, plus "building-block" plug-in display electronics packaged in a single desktop unit styled to complement the decor of office environments. The display is written from a parallel ASCII source at data rates up to 1620 characters per second. Received data is stored, and the cursor positioned, under control of memory address register in the terminal. This register responds to eight different command characters which serve to control cursor movement only and are not stored in memory or displayed on the screen. Each new character appears on the screen at the cursor position, overwriting any previously displayed character at that position. *Ann Arbor Terminals Inc.*

Circle 107 on reader service card

Universal multiplex can be interfaced with many systems

The KM-12/24 universal multiplex system permits switching of "Group, Pilot, Carrier, Signaling & Termination" to meet individual interface requirements. The KM-12/24 provides twelve duplex channels in the 60 to 108 kHz frequency band and twelve channels in the 12 to 60 kHz or 6 to 54 kHz frequency bands. It is a universal multiplex because of its inherent capability to interface with different multiplex systems with different frequency allocations, pilots, impedances and levels. Different system parameters are selected by switches in the Group Modem in accordance with individual system requirements.

The multiplex system is capable of transmitting up to twenty-four speech channels with bandwidths of 300 Hz to 3400 Hz, in the frequency band from 6 to 108 kHz. Integral out-of-band or optional inband signaling in the channel modems provide 2W or 4W, E & M dial or AC ringdown signaling facilities, which are switch selectable by a switch on the front of the individual channel modems.

The complete twelve-channel system including: twelve channel modems with built-in signaling, a group modem, twelve channel carrier generators, a two-channel order wire for operation in either the 8 to 12 kHz or the .300 to 2.16 kHz frequency bands, 2W, 4W and signaling jackfields, a −24 VDC power supply, and top-of-bay terminal block, occupy 22 rack spaces (38½ in. in a 19 in. rack). *Karkar Electronics Inc.*

Circle 108 on reader service card

Publications

A 24-page, two-color illustrated booklet, "Secondary Arrester Application Guide for Protection of Power Utilization Equipment" has been published by Joslyn Electronic Systems. The booklet discusses the problem of providing protection from damage by lightning, switching surges and other over-voltage disturbances originating on power distribution facilities serving AC-powered telecommunication, radio and electronic equipment. *Joslyn Electronic Systems Division.*

Circle 109 on reader service card

A two-page illustrated data sheet explains the features and operation of the RF-2810 Series High Band Porta Phones. Described are features such as multi-channel capability, two and five watts rf power output, power supply selection and compact construction. *Harris Corp.*

Circle 110 on reader service card

A complete line of signal and safety lanterns for use in various industries is featured in Bulletin 573 offered by Lintern Corp. Emphasis is placed on easy changing of lamps in a section devoted to Lintern Glowlites. Attention is given also to adaptation of the units for use in cranes, on panel boards, at indoor and outdoor safety stations, or in other areas where physical hazards must be identified. *Lintern Corp.*

Circle 111 on reader service card

Earth resistance testing with Vibroground test sets is described in a 32-page operation and application handbook, Manual 18507. The booklet describes how Vibroground instruments can be used as an important tool in preventive maintenance programs on ground rods, grids and mats to insure that they comply with grounding requirements. *Associated Research, Inc.*

Circle 112 on reader service card

A 32 page booklet describing the GTE Lenkurt 46A3 Multiplex System is now available. The 46A3 is designed to transmit toll-quality voice and data channels over long-haul microwave radio or coaxial cable facilities. *GTE Lenkurt Inc.*

Circle 113 on reader service card

A 28-page booklet covering the Lenkurt 11A Common-Channel Signaling System is now available. The 11A CCSS offers an alternative to conventional in-band, single-frequency signaling. The equipment functions by converting the signaling information of up to 24 telephone circuits into a 2400 b/s data stream that is assigned to one common voice channel. *GTE Lenkurt Inc.*

Circle 114 on reader service card

General Electric's TRS-296 solid-state microwave radio for Public Safety Industrial and Transportation use is described in a new brochure, ECM-285B. Operating in the 1.850 to 1.990 GHz range, the TRS-296 uses the same design as the widely accepted TRS-696B microwave radio. *General Electric Communication Systems.*

Circle 115 on reader service card

The General Electric TermiNet 1200 high speed data communication printer is described in Brochure DCP-1100A. The printer operates up to 120 characters per second or 1200 baud. It is designed for attended or unattended applications, order entry or billing, nationwide inventory control. *General Electric Communication Systems.*

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An informative catalog describing a complete line of special chemicals and

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Circle 13 on Reader Service Card.

aerosol products for the electronics industry is available for the asking. The catalog not only includes the Miller-Stephenson aerosols available but depicts, with line drawings, their application. It also includes a "Typical Maintenance Problems" chart which lists the equipment to be maintained, the cleaning problem, the remedy and the aerosol product which will solve the problem. *Miller-Stephenson Chemical Co., Inc.*

Circle 117 on reader service card

A new 10 page data sheet from Cushman Electronics describes the company's line of Communications Service Monitors for testing and maintenance of 2-way radios and microwave radios below 1 GHz. *Cushman Electronics, Inc.*

Circle 118 on reader service card

Publication of the Seventh Report to Congress on the High Speed Ground Transportation Act of 1965 and the Railroad Technology Program has been announced. The report covers FRA activities in carrying out the mandates of the Act during the year ending Sept. 30, 1973. *Federal Railroad Administration.*

Circle 119 on reader service card

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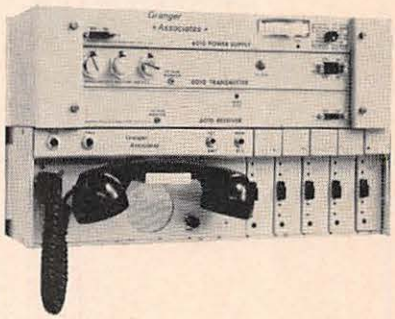

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Circle 14 on Reader Service Card.

Editor's Corner

Training Bulletin sequence

What sequence is RSC following in publishing the AAR Signal Training Bulletins (of which A-4 and A-5 appear in this issue)? Glenn Robertson (Chairman of AAR Committee G and Training Development Officer, Canadian National) explains:

"To facilitate numbering and indexing of AAR Signal Training Bulletins the members of the Committee G agreed that the subjects to be covered could be logically separated into several categories. It was decided that each category or series be identified by a letter and that each bulletin within the series be assigned a number. To date eight series have been identified as follows:

Series A—Signal Devices and Signal Accessories
Series B—Energy Distribution
Series C—Relays
Series D—Basic Signal Circuits
Series E—Highway Crossing Protection Systems
Series F—Signal Systems
Series G—Measuring Instruments
Series H—Miscellaneous

To designate a specific topic the bulletins are referred to as, B-6, C-4, E-1, etc.

In order that early training benefits may be derived from the Signal Training Bulletins each complete series will not be published in sequence. Instead, appropriate bulletins will be selected from each series and be presented in sequence towards attaining a specific training objective. For example, the training objective of the first bulletins issued will be to provide all the information necessary so that a trainee will know how a conventional DC track circuit operates. To do this the trainee will require information on track circuit components and the circuit. Therefore, early bulletins will include DC neutral relay C-1, C-2, C-3, & C-4; primary battery B-1 & B-2; bond wire A-1; insulated rail joint A-2; resistor A-4; lightning arrestor A-5; and direct current track circuit D-1.

The above sequence may change slightly to include the application of storage batteries to track circuits. If this is done, D-1 would not be published until after coverage of lead acid, nickel cadmium and nickel iron storage batteries and the methods used in charging them.

On completion of the DC track circuit lesson it is tentatively planned to follow this same building block approach culminating with the circuits for a basic flashing light crossing protection."

Reader response

RSC has been publishing the AAR's Signal Training Bulletins since March of this year. Since the members of the committee in charge of preparing the bulletins represent various railroads in North America, the new training bulletins are actually a product of the railroads designed for the railroads. Response to the training bulletins has been very good so far and orders for reprints continue to flow in. How are the users—maintainers, new engineers, supervisors and experienced employees—of the bulletins reacting to the content and format? It takes only a minute to write down your observations, so how about letting us know what suggestions or criticisms you may have. Of course comments pointing out the strong points of the bulletins are also welcome. As always—RSC will be glad to consider publishing any written comments.

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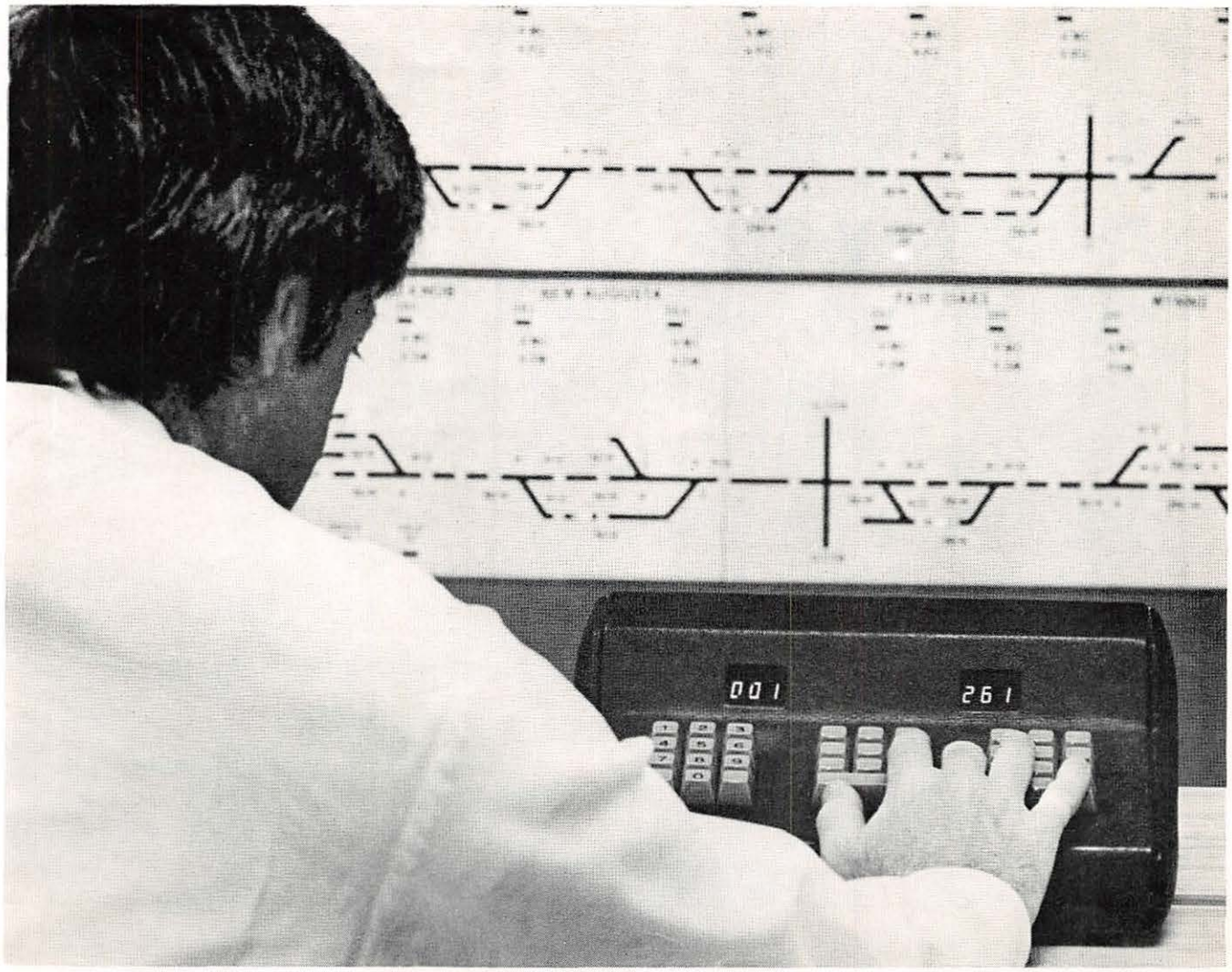

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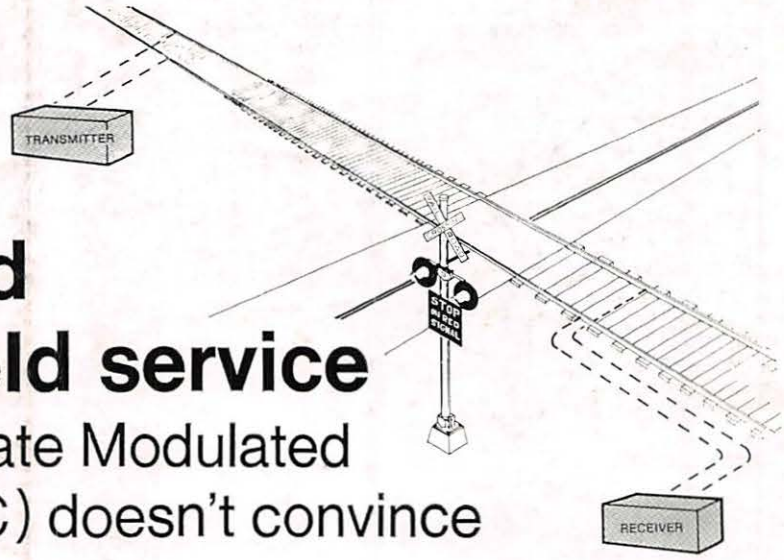

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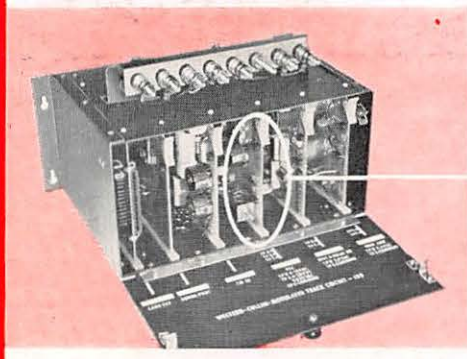

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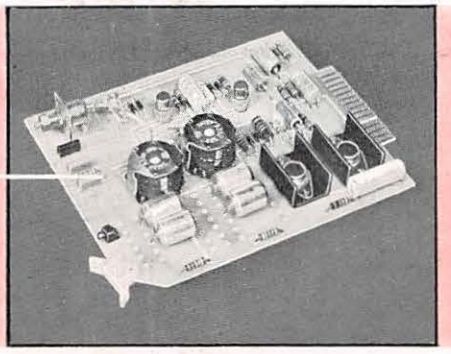

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